H. V. Eagles

Volume 20 MAY, 1936 Number 5

BULLETIN
of the
American Association *of* Petroleum Geologists

CONTENTS

BULLETIN

of the

AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS

OFFICE OF PUBLICATION, 608 WRIGHT BUILDING, TULSA OKLAHOMA

THE BULLETIN OF THE AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS is published by the Association on the 15th of each month. Editorial and publication office, 608 Wright Building, Tulsa, Oklahoma, Post Office Box 1852. Cable address, AAPGEOL.

THE SUBSCRIPTION PRICE to non-members of the Association is $15.00 per year (separate numbers $1.50) prepaid to addresses in the United States. For addresses outside the United States, an additional charge of $0.40 is made on each subscription to cover extra wrapping and handling.

British agent: Thomas Murby & Co., 1 Fleet Lane, Ludgate Circus, London, E. C. 4.

German agent: Max Weg, Königstrasse 3, Leipzig, Germany.

CLAIMS FOR NON-RECEIPT of preceding numbers of THE BULLETIN must be sent to the business manager within three months of the date of publication in order to be filled gratis.

BACK NUMBERS OF THE BULLETIN, as available, can be ordered from Association headquarters. Cloth-bound Vol. 2 (1918), $4.00; Vol. 3 (1919), $5.00; Vol. 5 (1921), $12.00; Vols. 11 (1927) to 16 (1932), Vol. 18 (1934), Vol. 19 (1935), each $17.00. Other volumes, many separate numbers, and a few nearly complete sets are available. Descriptive price list sent on request. Special prices to members and associates. Discounts to libraries. Detailed *10-Volume Index* (1917–1926), $1.00. *Structure of Typical American Oil Fields*, Vols. I and II (1929), each volume $7.00 ($5.00 to members and associates). *Stratigraphy of Plains of Southern Alberta* (1931), $3.00. *Geology of California* (1933), $5.00. *Problems of Petroleum Geology* (1934), $6.00 ($5.00 to members and associates). *Geology of Natural Gas* (1935), $6.00 ($4.50 to members and associates).

THE BULLETIN furnishes thirty-five reprints of major papers. Additional reprints and covers for all or part are furnished at cost. ORDERS FOR REPRINTS should accompany corrected galley proof.

Association Headquarters—608 Wright Building, 115 and 117 West Third Street, Tulsa, Oklahoma

Communications about the Bulletin, manuscripts, editorial matters, subscriptions, special rates to public and university libraries, publications, membership, change of address, advertising rates, and other Association business should be addressed to

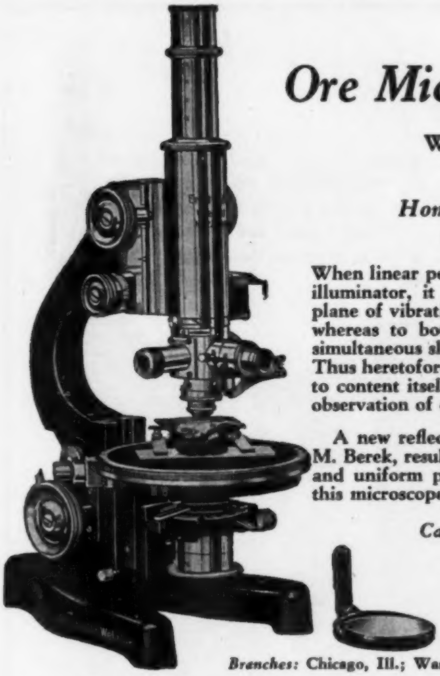
THE AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS, INC.

BOX 1852

TULSA, OKLAHOMA

Entered as second-class matter at the Post Office of Tulsa, Oklahoma, and at the Post Office at Menasha, Wisconsin, under the Act of March 3, 1879. Acceptance for mailing at special rate of postage provided for in section 1103, Act of October 3, 1917, authorized March 9, 1923.

Illustration courtesy of L. L. Brown Paper Company, Adams, Mass.



Articles for June *Bulletin*

Marine Conglomerates, Marine Unconformities, and Thickness of Strata
By W. H. Twenhofel

Movements of Ground Waters
By O. E. Meinzer

Salt-Dome Statistics
By George Sawtelle

Conroe Oil Field, Texas
By Frank W. Michaux, Jr., and E. O. Buck

Oil Pool of Open Reservoir Type
By John Emery Adams

Source Material for Petroleum and Natural Gas
By Wilber Stout

Age of Mississippian "Ridgetop Shale" of Central Tennessee
By Charles W. Wilson, Jr., and E. L. Spain, Jr.

Price of Crude Oil in Perspective
By Joseph E. Pogue

BULLETIN ADVERTISERS

PROFESSIONAL CARDS

GEOLOGICAL AND GEOPHYSICAL SOCIETIES

Volume 20 Number 5

BULLETIN
of the
AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS

MAY, 1936

STRATIGRAPHIC VERSUS STRUCTURAL ACCUMULATION[1]

A. I. LEVORSEN[2]
Tulsa, Oklahoma

ABSTRACT

Heretofore practically all petroleum geology has been directed toward a search for domes and anticlines and other local deformation. This has been adequate to maintain a satisfactory discovery rate and will continue to be adequate as long as the supply of anticlines holds out. Due to the accuracy and rapidity with which we can map structure, it may be that before long we shall be faced with a shortage of favorable anticlines. Such a shortage, however, should not mean a shortage of oil, but should serve merely to change our approach to the problem of oil discovery. Stratigraphic methods offer such a change. Stratigraphic traps have accounted for one-fourth to one-third of the past production and there is no reason why we may not expect a much greater percentage in the future under the stimulus of a continuing demand and through scientific methods. Stratigraphic methods offer an almost unlimited field for petroleum geologists with a promise of results in terms of oil adequate to meet national demands.

Twenty years ago last October a group of twenty-seven geologists living in Oklahoma met in Tulsa at the call of J. Elmer Thomas and it was decided that an association of geologists should be organized as had previously been proposed by E. L. DeGolyer and Charles H. Taylor. Out of this beginning grew The American Association of Petroleum Geologists, the membership of which now exceeds two thousand one hundred fifty. This growth in membership has been in proportion to the growth of the oil industry and is direct evidence of the positive value which the oil industry recognizes in the application of the science of geology to its peculiar problems.

With this growth in membership has come an increased responsi-

[1] Presidential address read before the Association at Tulsa, March 19, 1936.

[2] 221 Woodward Boulevard.

bility. As never before, the oil industry, and back of it the nation, have come more and more to depend upon the applications of geology for guidance in the maintenance of our petroleum reserves. We have become the great, scientifically thinking group particularly concerned with the discovery of oil and gas. Though many discoveries have been made in the past by so-called non-scientific methods and undoubtedly will continue as long as there is a "wildcatter" left, the future reserves of the nation most certainly can not be depended upon tocome through such haphazard methods. A billion barrels of new oil a year is a large order and the responsibility for finding it is coming to rest squarely upon our shoulders, individually and collectively.

Since we have made great gains physically, both in our numbers and in our influence, we might well ask ourselves what progress we have made in the quality of our thinking. For there lies the only true measure of our growth. Are our theories, methods, and ideas adequate to guide the oil industry into those paths where it will continue to maintain a discovery rate equal to its needs over a long period of time? Concern is expressed in many quarters that we are facing a declining discovery rate during the next decade and that there is nothing we can do about it. If that is even a possibility, it might be appropriate to examine briefly some of our ideas and theories, particularly those far out on the frontiers of our knowledge, to see if they might not be extended or improved. It might be worth while also to see if we are making the fullest application of our science and so warrant the continuing respect of the oil industry.

We have arrived at our present position of trust almost entirely through our application of the anticlinal theory to the problem of oil discovery and we have attacked the business of locating anticlines, folds, and local deformation most energetically. Up to 1925, almost all of our work was surface mapping and there is probably no single county in the United States, underlain by sedimentary rocks, the surface of which has not been scrutinized by the field geologist. In fact, many counties have been examined in minute detail many times by scores of geologists. The core drill was then used to assist in locating folds in those areas which could not be mapped by surface observation, and, particularly in many parts of the Mid-Continent, core drilling flourished and was successfully applied for several years. The search was always for closed structure. With the increase in the number of oil wells, subsurface structure mapping became an important part of our work and now occupies the time of a large percentage of our members. For several years contours were made in great abundance and at relatively low cost by magnetic methods

—until it was finally learned that these did not necessarily reflect the structure of the sedimentary rocks which contained the oil and gas. Aerial photography was used in the search for anticlines with success in many localities and has been and continues to be of particular assistance in the areas characterized by strong folding and inaccessibility. Gravity anomalies determined by the torsion balance are often interpreted into structure and, particularly in the Gulf Coast region, have been found to assist materially in the search for buried domes and salt plugs. The remarkable progress which has been made in seismic methods during the past few years has resulted in the mapping of structure at great depths with almost uncanny accuracy. The presence of 180 geophysical parties at work in the United States alone is sufficient proof of the position which geophysics has reached in the eyes of the practical operator searching for oil.

However, by whatever method used, the search has been always for local deformation such as anticlines, domes, faults, and similar features. We began looking for such structure at the surface by surface methods and we have progressively deepened the plane of our search until we are now actively searching for domes which occur at depths of 5,000 to 10,000 feet and in some areas even deeper. The present wave of seismic exploration at these great depths might be said to be the last stand of local structure to escape detection and these geophysical methods are rapidly finding all of the folds and local deformation which were missed by previous methods. As each method of structure hunting was developed, it provided a sufficient number of new folds for exploitation so that the current petroleum needs were met. We have all, therefore, drifted along from one structure-finding method to another until now we are apparently approaching the real danger of an oversupply of methods and an undersupply of anticlines.

One major criticism which I think can be made of our approach to the problem of oil discovery is that we have been too closely confined in our efforts to a search merely for local deformation. We have led the oil operators, executives, and managers of our oil companies to believe in the magic of the closed structure contour until it is generally believed, by both geologists and non-geologists, that our future reserves are largely limited by the extent to which we are able to find new domes and anticlines. Such a philosophy has been adequate and will continue to be so just as long as there are enough anticlines. But, if we are to depend on folding alone, our future discoveries are indeed limited, for we are undoubtedly running low on the supply of untested domes and anticlines. Is it not possible that the dwindling

reserve is not so much of oil as it is of closed structures? And is it not possible that this in turn only reflects a dwindling reserve of the logical and speculative thinking necessary to discover oil reserves dependent upon conditions other than structure alone?

Since the search for domes, anticlines, and similar types of local deformation has been our chief method of attacking the problem of oil discovery, and if we are approaching the end of our supply of such structures for the very reason that we are rapidly exhausting our finding methods down to the lowest depths at which we can drill oil, then what of the future? Where are we to find this billion barrels of new oil per year which all observers seem to think the nation will require for many years to come? The oil industry is not interested in our contours, in our gravity maxima and minima, in our rock velocities, our theories; it is interested in us only in so far as we can tell where to drill to find barrels of oil. It is our job to find this oil and if we fail, the industry will find someone else to do it.

May I suggest a practical constructive geological approach to the problem in a method which has heretofore, with few exceptions, been almost untouched by scientifically trained workers but the casual application of which has accounted for at least a quarter and possibly a third of our total past production? It is the wider—much wider—use of stratigraphic methods. As geologists we have been chiefly concerned in our past work with the oil which is found in structural traps and have sadly neglected the oil which occurs in stratigraphic traps.

A stratigraphic trap may be defined as one in which a variation in the stratigraphy is the chief confining element in the reservoir which traps the oil. All oil and gas found so far occur in gravity adjustment within their containing reservoir; in some the dominant trap-forming element is a local deformation such as a dome, an anticline, or a fault closure; in others the dominant trap-forming element is a wedging or pinching-out of the sand or porous reservoir rock, a lateral gradation from sand to shale or limestone, an uplift, truncation and overlap, or similar variation in the stratigraphic sequence. Stratigraphic changes, by their very nature, are of broad and widespread extent and once discerned can be traced in many places for long distances. Many oil pools which are found in stratigraphic traps are therefore of large size, as can readily be shown in such outstanding examples as the East Texas field in Texas, the Glenn and Nowata pools in Oklahoma, and the Coalinga and Midway-Sunset pools in California, not to mention scores of other pools throughout the producing belts. Not only are many of the individual pools of major proportions where located at the edge of porosity, but it can be shown that many if not

most of our so-called oil provinces (regions which produce prolifically at a number of places for related reasons) contained a regional stratigraphic variation early in their history, which has, in effect, been a strong controlling factor in the oil accumulation in the region ever since the reservoir rock was buried. Stratigraphic traps and stratigraphic methods are therefore of wide importance. These conditions of oil occurrence are not new to geologists, because oil in some of the oldest pools has long been known to have been trapped chiefly by stratigraphic variation in the reservoir rock, yet for some reason these conditions have been generally overlooked or neglected in our scramble for closed structure.

Of the 22 largest oil pools in the United States, more than half of the oil production was obtained from pools in which the dominant trap-making element was a change from porosity to non-porosity.

TABLE I

RECORD OF LEADING PRODUCING FIELDS OF THE UNITED STATES*
(From the *Oil and Gas Journal*, October 31, 1935, page 12)

Year Opened			*Total Production to Dec. 31, 1934 (Bbls.)*
▶1901	◆	Midway-Sunset, Calif.	766,916,874◀
▶1930	◆	East Texas, Tex.	611,071,184◀
1926		Seminole Field, Okla.	554,004,822
1921		Long Beach, Calif.	525,245,127
1920		Santa Fe Springs, Calif.	385,662,713
▶1922	◆	Smackover, Ark.	344,623,786◀
▶1896	◆	Coalinga, Calif.	333,802,296◀
▶1875	◆	Bradford, Penn.	331,086,818◀
1912		Cushing, Okla.	319,800,831
▶1900	◆	Kern River, Calif.	296,707,182◀
1916		Butler County, Kans.	264,166,477
1889		Salt Creek, Wyo.	257,868,387
1928		Oklahoma City, Okla.	249,461,391
1920		Huntington Beach, Calif.	217,671,266
▶1906	◆	Glenn Pool, Okla.	198,363,132◀
1926		Yates, Tex.	195,383,327
▶1920	◆	Burbank, Okla.	185,617,560◀
1926		Hendricks, Tex.	177,984,872
1913		Healdton, Okla.	177,298,695
1916		Ventura Avenue, Calif.	151,244,008
1897		Fullerton, Calif.	150,586,007
▶1916	◆	Bristow-Slick, Okla.	145,865,526◀

* ▶ Fields in which the chief trap-forming element is the stratigraphic change from porosity to non-porosity.

Not a single one of these pools of stratigraphic type would have been discovered by our present orthodox geological methods unless it happened that there was a local dome or anticline present within the area of the pool!

In some ways it is like hunting in Africa with air rifles and pop

guns and never realizing that there is big game in the country even after the natives repeatedly bring in lions and elephants. We have gone after our structures with increasing minuteness—in fact we even name them after such minor features as "wrinkles," "noses," and "pimples"—and we have left the big game hunting to the untrained hunter—the casual "wildcatter." Half of the "elephant" pools of the country are of the stratigraphic type. If such has been the past record, without scientific methods, what might not the future hold for those who will give serious consideration to the problem?

It seems to me that there are several closely related sets of stratigraphic conditions which offer possibilities for future discoveries beyond anything we have ever dreamed in our present geological thinking. They are: (1) flank sands on known domes and anticlines, (2) new geologic conditions revealed below regional unconformities, and (3) up-dip wedge-shaped porosity.

1. FLANK SANDS ON KNOWN DOMES AND ANTICLINES

How fortunate it was for those owning leases in the Oklahoma City field that the discovery well should have found oil on the top of the structure where the well known producing Simpson formations were stripped off by pre-Pennsylvanian erosion! It would have taken a brave soul indeed to have recommended a second deep well down the west flank in the face of a dry hole on the top of the anticline. It was 17 years before geologists recommended drilling the west flank of the Billings dome in Noble County, Oklahoma, where the top of the fold was barren due to a similar erosion of the producing Simpson formations. This, as you know, is a recent discovery where large production has been found down the west flank in the "Wilcox" sand and gives promise of being a pool of importance. I believe it was Ben Belt who so aptly named these "bald-headed" structures. The same principle accounts for the prolific flank production in the Spindletop, Sour Lake, and Humble pools on the Gulf Coast. Many of our so-called dry structures may be dry because of their being "bald-headed."

Up to the present, outside of the Gulf Coast, little or no concerted scientific effort has been made to find oil occurring under these conditions. Beyond a doubt it represents a field for oil discovery of major importance. The Ardmore district in Oklahoma, and the entire Gulf Coast belt of the Tertiary are only two of the wonderful hunting grounds for this kind of game. This type of production has been found in each of these provinces in the past; each contains numerous eroded structures whose flanks are untested; and each province has had

sufficient development so that a geologist has plenty of material with which to work.

Many other districts have structures containing flank sands of this type waiting to be tested. Two individual examples with which you are all familiar are the Jackson dome in Mississippi and the Fort Stockton "high" in West Texas, both of which have eroded tops, and are on a scale which warrants the belief that if flank production is ever found it will be on a big scale. And, in thinking of this character of accumulation, let us not forget that the Nemaha buried ridge of Kansas and Nebraska has the largest "bald head" of all and a geologic history very similar to that of some of the smaller examples which are now flank producers.

2. NEW GEOLOGIC CONDITIONS REVEALED BELOW REGIONAL UNCONFORMITIES

All of us are prone to condemn too much. One reason why we condemn a prospect is because we so often forget there are unconformities in the stratigraphic section to be drilled. Yet our records are full of examples of major structure completely covered and obscured by later sediments. Who, for example, in advance of the drill, could have foreseen the Central Kansas uplift with its cover of uniformly north and west-dipping Permian and Cretaceous rocks? Or the hidden geologic conditions below the normal west-dipping Carboniferous rocks of Oklahoma? Or the Bend arch of North Texas so completely obscured by the overlapping west-dipping Pennsylvanian strata? In each example a notably different geology—both structural and stratigraphic—was uncovered below the regional unconformities, from that found above them. And, in each of these examples, the geologic history of the concealed rocks was such as to have caused the accumulation of great oil and gas deposits.

Since we are rapidly exhausting the discovery of new structural and stratigraphic conditions at the surface of the ground, the future oil discoveries of the nation must to a large extent be found under buried geological conditions of which we now have only faint, if any, knowledge. Two such areas which are now taking form on the discovery frontier and which exemplify the possibilities of new geologic conditions concealed below unconformities are (1) the Comanche rocks of northern Louisiana, northeast Texas, and southern Arkansas, where 5,000 to 10,000 feet of hidden sediments are folded, tilted, deformed and completely overlapped unconformably by Upper Cretaceous rocks in a manner to warrant the expectation of ultimately discovering oil and gas deposits of national importance, and (2) the

recent development in the pre-Carboniferous rocks in West Texas. There great thicknesses of oil-bearing Ordovician sediments, which have been folded, locally deformed and eroded, and show great lateral changes in porosity—all of which are the fundamental prerequisites for an oil province—are found to occur on a gigantic scale under a cover of rather low-dipping Carboniferous rocks. A geologic setting is being uncovered which leads one to expect that the future discoveries of West Texas, in the Ordovician rocks alone, might easily exceed anything which the oil industry has ever encountered in the past.

In addition to these two examples, there are less clear outlines of similar, buried regional conditions in many states and areas which are now not producing. Thus Nebraska, Colorado, and in fact most of the Rocky Mountain states, Florida, Georgia, Alabama, and Mississippi are only a few such states, where present indications are that future drilling will reveal buried geologic conditions which we can not now map but which will be of such magnitude and of such character that if oil is present at all it promises to be in great quantities.

3. UP-DIP WEDGE-EDGE POROSITY

To this classification belong such pools as the Burbank, Glenn, and Nowata pools in Oklahoma, the Cherokee sand pools of Kansas, the Coalinga pool in California, the Clinton gas pools in Ohio, and the East Texas and Government Wells pools in Texas, together with a host of lesser pools whose principal trap element is the lateral change from porosity to non-porosity. These are sometimes called "shoreline" pools, "sand lens" pools, or "shoestring" pools.

There are literally hundreds of sandstones in the United States, every one of which was laid down in the shape of a lens. The edges of some of these lenses have been eroded and are now gone; in other places the porosity edge faces or pinches out down the dip and consequently a trap is not formed; but in innumerable instances the porosity edge faces or pinches out up the dip, has remained in this attitude ever since it was formed, and is now untested. In addition, the stratigraphic history of almost every sedimentary region in the United States contains at least one, and in many places several, periods when regional uplift, truncation, and overlap have occurred. The buried overlap of truncated sandstones and porous limestones constitutes one of the most favorable conditions by which such traps are formed and offers a vast and practically untouched field for exploration.

The East Texas pool is the most recent major discovery of this type of accumulation and because of its great size and economic importance should have focused the attention of everyone on the possi-

bility of discovering other pools of this character. The expression is commonly heard that there are no more like it in size. Certainly such a pool will never be found under our present geological methods except by accident. Yet there is hardly a producing or non-producing district or state, from Pennsylvania to California, underlain by sedimentary rocks, in which untested porosity wedges are not present, and in many places they can be shown to be on a scale equal to that of the East Texas area. As far as I know, there is no geological reason why we may not look forward with confidence to the ultimate discovery of not one but several pools comparable in size with the East Texas field.

These three occurrences of oil of stratigraphic type are all closely related in principle, differing chiefly in size. Thus, the flank production of Spindletop, the Simpson flank production at Oklahoma City, and the East Texas production down the west flank of the Sabine uplift have much in common in type of geologic history and in conditions of occurrence, and each should be susceptible of discovery by geologic methods. One does not appreciate the possibilities of this sort of geology until time and thought have been given to it, and I venture to say that upon investigation you will each of you reach the conclusion, as I have, that there are yet to be discovered oil and gas reserves almost without limit by those who may become adept in stratigraphic analysis.

When hunting elephants one needs elephant guns. The elephant guns of stratigraphic oil discovery are, *first*, a liberal drilling policy, and, *secondly*, the most careful and complete sampling of the drilled formations that is possible. The accurate analysis of these samples, the correlation and comparison of the results in the form of sand maps, paleogeologic maps, cross sections, overlaps, isopach maps, and geologic history are the ammunition we shall need. The working out of a technique which will permit us consciously to prospect for reserves of the stratigraphic type will require much coöperative effort, free exchange of information, and an intelligent patience on the part of geologist and operator alike.

Differing from our past methods, the possibilities for stratigraphic production can not be quickly exhausted, and the final story of oil in most districts will not be written for many years to come. Geophysics will be of assistance, but its chief application will be in detecting thin wedges of sediments and of porosity changes, an application which is not now made. The surface geology of many areas can be reworked, with emphasis on stratigraphic variations rather than surface structure and the results in terms of oil discovery may be of even

greater value than our earlier structural studies. Much of our past petroleum geology has been concerned with "high" and "low," whereas I foresee a change to "present" or "absent." The basis of the first is engineering, the basis of the last is pure geology.

In conclusion, may I offer the personal observation that the day of geology, as applied to the practical problem of discovering a continuing oil reserve for our nation, is just dawning. There can be no doubt that an abundance of oil in terms of national demand remains to be discovered. The discovery of this oil is not going to be easy and offers a real challenge to each of us. Our future is limited only by our ability to reason geo-logically and the foundation for such reasoning is a real knowledge of geology, more geology, and then still more geology.

BULLETIN OF THE AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS
VOL. 20, NO. 5 (MAY, 1936), PP. 531-559, 9 FIGS.

ORANGE, TEXAS, OIL FIELD[1]

ALEXANDER DEUSSEN[2] AND E. W. K. ANDRAU[2]
Houston, Texas

ABSTRACT

The Orange, Texas, oil field was discovered in 1913. It is a deep dome, in which salt has never been encountered in drilling. The peak of development and production was reached in 1922. Four hundred twenty-four locations have been drilled, of which 318 wells produced oil and 106 wells were dry. The greater portion of the oil is produced from Pliocene-Miocene sands. Oligocene oil is found southeast of the Miocene oil-producing area. This is due to a faulted condition of the dome. The average depth of the wells is 4,000 feet. The average total production is 79,000 barrels per well drilled.

INTRODUCTION

The Orange oil field was the second deep salt dome discovered in the Gulf Coastal region of Texas. It has not been previously described in a comprehensive geological paper and it is the purpose of the writers in submitting the present paper to supply information on this field in so far as it is possible to do so with the data at command.

Gulf Coast drilling prior to 1922 supplied only very meager subsurface data, in general inadequate for the construction of an accurate, detailed picture of the subsurface structure.

LOCATION

The Orange oil field is located about 6 miles west of the town of Orange on Cow Bayou in Orange County, Texas, and about 1.5 miles south of the main line of the Southern Pacific Railway (Fig. 1).

HISTORY OF DEVELOPMENT

The presence of oil in this area was suspected by several individuals shortly after the discovery at Spindletop. Gas seepages, "paraffine dirt," and strong sulphur springs were among the indications that prompted this belief. The first well in this locality was drilled in 1903 on the Josh Bland tract on the bank of Cow Bayou immediately adjacent to a strong sulphur spring (Fig. 2). Its owners, J. W. Link and

[1] Presented before the Association at the Houston meeting, March 24, 1933. Manuscript received, February 15, 1936.

[2] Consulting geologist.

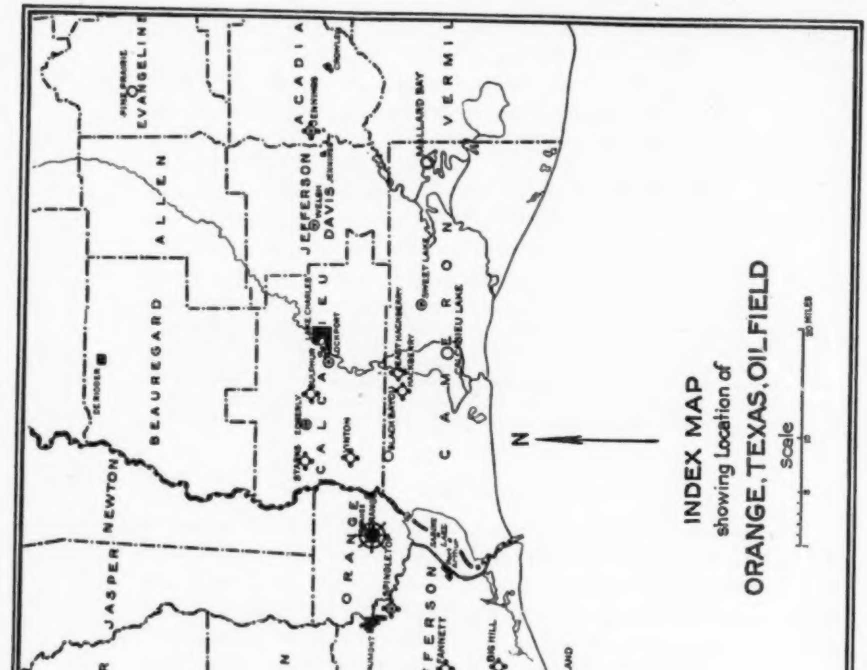


FIG. 1.—Index map showing location of Orange, Texas, oil field.

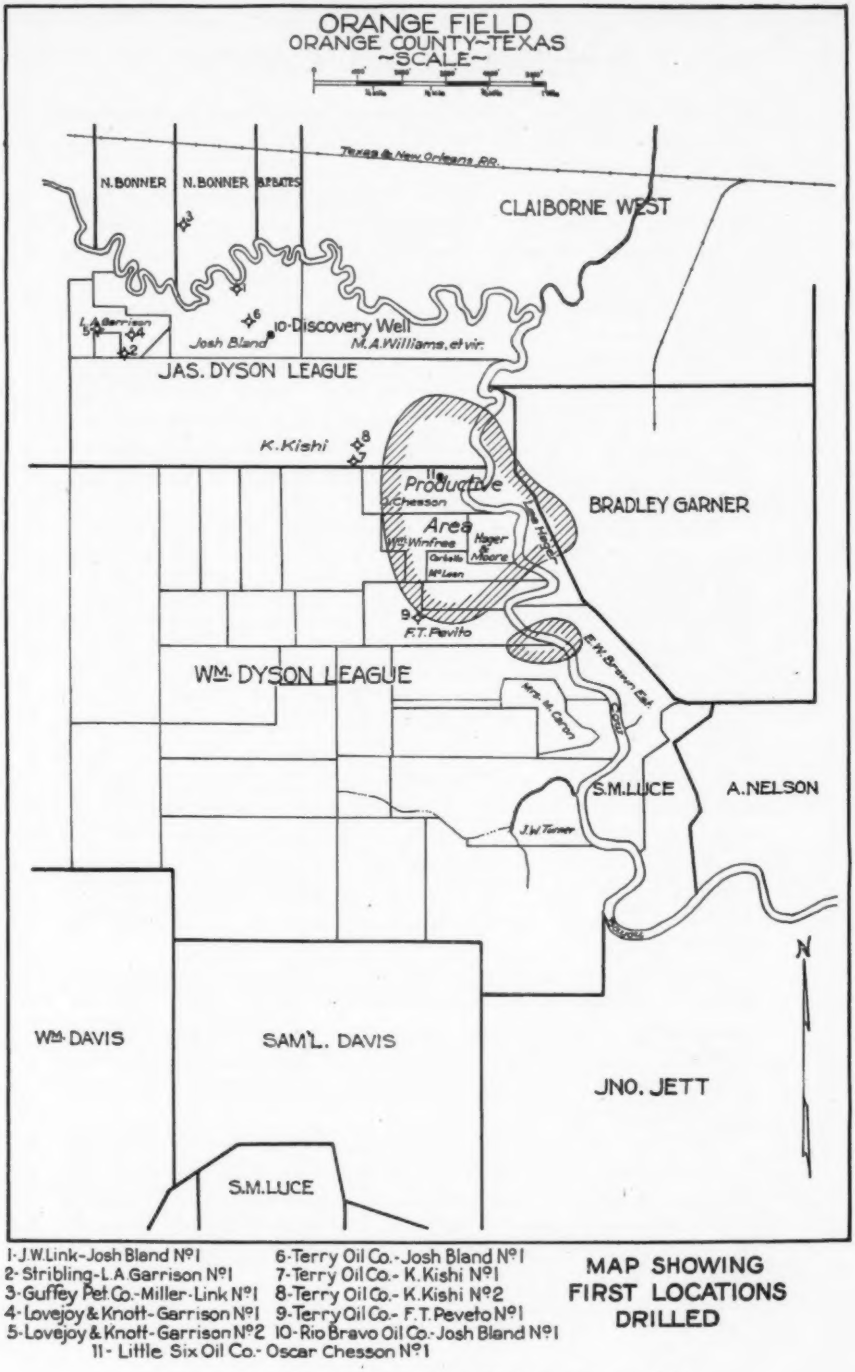


Fig. 2.—Map showing first locations drilled in the Orange field.

associates, of Orange, Texas, who formed the Hanford Oil Company, drilled and abandoned the well at a total depth of 1,904 feet without finding any production.

The second well was drilled by Stribling (Brotcher well) in 1905, on the Lon Garrison farm, and abandoned at a depth of 1,500 feet.

The next well, located on the Miller-Link lease on the opposite side of the Bayou from the original Link well, was drilled by the J. M. Guffey Petroleum Company in 1909. It was abandoned at an approximate depth of 2,000 feet, without entering any oil formation.

In 1911, Lovejoy and Knott took up some holdings in this vicinity and drilled two wells on the Garrison lease, west of the Bland tract, where the first well was drilled. Lovejoy and Knott's Garrison well No. 1 was drilled and abandoned in 1911 at a total depth of 1,100 feet. Their well No. 2 was drilled northwest of the No. 1, in the year 1912, and likewise abandoned without yielding any oil.

During the latter part of 1912, the Lovejoy and Knott holdings were taken over by F. J. Clemenger, W. C. Moore, and associates, who organized the Terry Oil Company. This company drilled four wells. The first well was located on the Josh Bland tract about 1,000 feet south of the original Link well and operations started in March, 1912. The hole was abandoned at a depth of 2,000 feet after some showings of gas had been encountered. Kishi No. 1, the next well, was located about 4,000 feet southeast of the first one. It was drilled to a depth of 1,250 feet and abandoned. The company then moved to a location (Kishi No. 2) 400 feet north of their Kishi No. 1, and started drilling in the spring of 1913. A total depth of 3,128 feet was reached, with a number of very promising oil showings between 2,780 and 3,128 feet. A small amount of oil was encountered which was soon drowned out by water. The well was later taken over by the Orange Petroleum Company (Stark, Miller, and Brown) and reworked, but without success.

Following the completion of Kishi No. 2, the Terry Oil Company started a test on the Pevito lease (Pevito No. 1) about 4,000 feet south-southeast of their Kishi No. 1. This well, which was drilled to a depth of 1,303 feet, had a blow-out, which later attracted additional development in this vicinity and led to the actual discovery of the present production.

The Terry Oil Company, while drilling the previously mentioned four wells, made a contract in 1913 with the Rio Bravo Oil Company whereby the latter company obtained a portion of the Terry Oil Company's leases and agreed to drill a well on these holdings. This well, the Rio Bravo Oil Company's Bland No. 1, was the discovery well of

the Orange field. It was located 700 feet southeast of the Terry Oil Company's Bland No. 1 and was completed on August 17, 1913, as a 150-barrel well in a sand from 3,209 to 3,227 feet. It was at that time the deepest producing oil well in the state.

This well was pumped continuously for more than 10 years, and yielded in excess of 100,000 barrels of oil. It lies ¾ of a mile north of the main producing area. Many tests have been drilled in the immediate vicinity of this well, but no other has been successfully completed.

An active drilling campaign followed the discovery of the Rio Bravo Oil Company's Bland No. 1, and the following companies entered the field at this time: the Producers Oil Company (now The Texas Company), with four wells; the Rio Bravo Oil Company, with two wells; the Higgins Oil and Fuel Company, with three wells; and the Harper Oil Company, with one well. None of the wells drilled by these companies established additional production. The location of these tests is shown in Figure 2 (see also Table II).

The outbreak of the European war in 1914 and the disappointing results of the tests afore-mentioned stopped operations, and no further serious effort to find production was made until 1920, six years after the active period of 1913–1914. However, during the quiescent period, the following tests were completed.

In 1916, the Orange Petroleum Company finished their offset to the Rio Bravo Oil Company's Bland No. 1 as a dry hole at 1,820 feet.

In 1916, the Orange Petroleum Company drilled Kishi No. 1, a few yards distant from the Terry Oil Company's Kishi No. 2. The total depth was 3,300 feet.

In 1917, the Bland Oil Company drilled an offset to the discovery well, the Rio Bravo Oil Company's Bland No. 1. This was drilled to a depth of 3,090 feet and completed as a 35-barrel oil well, but was shortly abandoned.

In 1918, the Beck Petroleum Company drilled a well a few yards northwest of the Terry Oil Company's Kishi No. 2. It was abandoned at a depth of 3,390 feet.

In 1919, the Little Six Oil Company acquired holdings in the Orange field and started a test on the Chesson lease. This well, Chesson No. 1, was commenced in March, 1920, and was completed at an approximate depth of 1,760 feet, with an initial production of 50 barrels (on the pump). This well was the first producer in the present productive area of the Orange field, and the second producer of any consequence in the district. This discovery immediately resulted in a very active campaign on the part of the major oil companies and initiated the development which constitutes the present Orange field.

Completions in this interval followed each other in rapid succession. The detailed history is given in Table I.

The Humble Oil and Refining Company's Chesson No. 5 proved a deeper, highly prolific horizon, which has since been known as the "4,000-foot pay sand."

TABLE I

CHRONOLOGICAL DRILLING HISTORY OF 1921

Completion Date	*Company*	*Well*	*Initial Production in Barrels*	*Depth to Producing Level in Feet*	*Remarks*
1/18/21	Toale Oil and Drilling Co.	Chesson 1	50 (Pump)	2,014	Toale Co. was later taken over by Orange Petrol. Co.
3/ 5/21	Little Sir Oil Company	Chesson 3	130	2,036	
4/27/21	Orange Petrol. Co. (Toale Drilling Co.)	Winfree 1	150	3,000–3,074	
5/14/21	Brown Estate	Pevito 1	150	2,748	1,600 feet south of Orange Petrol. Co. Winfrey 1
8/13/21	Humble	Winfree 1	700	3,100	
10/ /21	Brown Estate	McLean 1	500	3,321	Later reworked
10/ 8/21	Edgerly Petrol. Co.	Carbello 1	5,500	3,350	Strong blow-out with estimated gas flow of 50,000,000 cubic feet
11/20/21	Orange Petrol. Co.	Winfree 3	250	3,343	
12/ 6/21	Orange Petrol. Co.	Chesson 3	250	3,427	Later deepened to 3,700 feet
12/15/21	Gulf Prod. Co.	Winfree Fee A 1	4,100	3,400	
12/15/21	Edgerly Petrol. Co.	Carbello 2	3,500	3,328	
12/24/21	Gulf Prod. Co.	Winfree Fee 1	2,500	3,400	
12/28/21	Humble Oil and Refg. Co.	Chesson 5	14,000	3,900	Flowed at this rate a month, then sanded up. It was cleaned and began flowing 4,000 barrels, February 23, 1922; 27 per cent water and basic sediment.

The peak of development was reached in 1922. In this year the field was extended east of Cow Bayou. It was also found that the "4,000-foot pay" was not a continuous sand body, but that oil sands were situated at various levels. With these conditions it happened that casing was commonly set through the oil sands, or was set too high. Adequate subsurface control was lacking, and the shutting-off of water from the oil sands was found to be unusually difficult. Additional pay sands were encountered below 4,000 feet; however, all were in the Miocene.

In 1924, a new extension was made farther south, when the Sun Oil Company's Mrs. C. L. Brown *et al.* No. 2, and the Rycade Oil Company's State E No. 1 found commercial production in the Oligocene. Oligocene production is restricted to the south end of the field.

Location of the several wells mentioned in preceding paragraphs is shown in Figure 3.

COMPANIES OPERATING IN ORANGE FIELD, NOVEMBER, 1935, WITH NUMBER OF PRODUCING WELLS

Company	*Number of Producing Wells*
Brown Babbette Oil Company	5
Humble Oil and Refining Company (farmed out to C. L. Brown)	2
Continental Oil Company	5
S. A. Emerson	8
Gulf Production Company	3
C. C. Keown (formerly Orange Petroleum Company)	2
Orange Petroleum Company	10
Sinclair Oil and Refining Company	15
Sun Oil Company	1
Birmingham Oil Company	1
Tillery Oil Company	1
Total	53

PRODUCTION

Production of the Orange field by years is as follows.

PRODUCTION OF ORANGE FIELD*

Year	*Barrels*
1913	17,706
1914	43,208
1915	21,697
1916	17,758
1917	7,023
1918	—
1919	4,400
1920	4,000
1921	470,000
1922	5,345,000
1923	4,649,000
1924	3,958,000
1925	4,816,000
1926	3,458,000
1927	1,803,000
1928	1,415,000
1929	1,006,000
1930	790,000
1931	618,000
1932	451,000
1933	312,000
1934	291,206
1935	263,200
Total	29,761,198

* *Oil Weekly*, Vol. 80, No. 7 (January 27, 1936), p. 110.

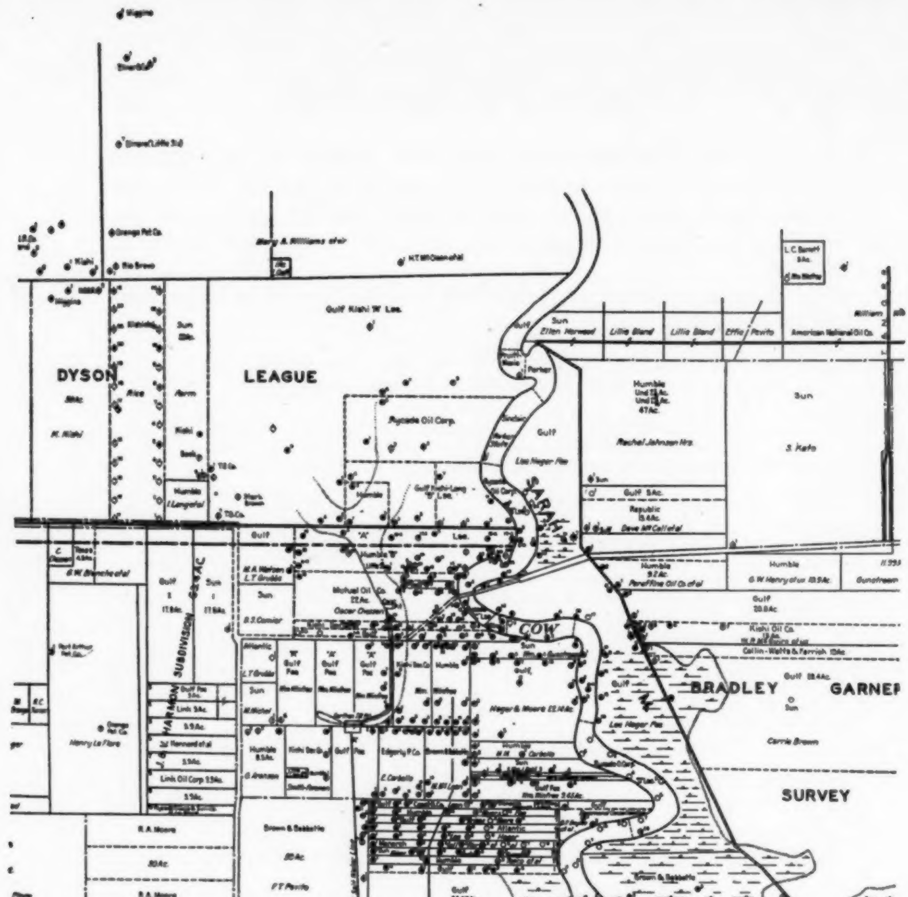


FIG. 3.—Map of Orange field, showing location of oil wells, dry holes, et cetera. Scale in feet.

TOPOGRAPHY AND SURFACE GEOLOGY

The Orange field is in the wooded lowlands flanking Cow Bayou, in the center of that part of the Texas-Louisiana Coastal Plain characterized by many oil-producing salt domes. The elevation is 8–12 feet above sea-level. The Beaumont clays crop out on the upland adjacent to the field. No topographic or surface geological features delimit the area of oil production, with the exception of seepages of gas and excellent occurrences of "paraffine dirt."

GEOPHYSICS

The Orange field was, of course, discovered and developed in the days before the introduction of geophysical surveys into the Gulf Coast. However, since the introduction of geophysics, the field has been surveyed in this manner and the results may be summarized as follows.

An anomaly in the gravity field, associated with established oil accumulation in the Orange field, proves this to be a deep salt dome. This anomaly, on its weakest flank, which is toward the Port Neches field, has a magnitude of -2.0×10^{-3} C. G. S. A complete gravity survey of the dome has not been available to the writers, but the evidence obtained shows the northwest-southeast axis of the present producing area to coincide with the same axis of the local gravity anomaly, and this axis is, in fact, coincident with the structural crest.

No deductions as to the depth of the salt can be drawn from the gradient pattern, since the distance between crests of the reversal in gradient is too great to be diagnostic.

Refraction fan shooting was carried out in 1927. The length of shot averaged less than 4 miles, and, although accelerations were recorded, suggesting the presence of abnormal subsurface conditions, no salt velocities were obtained; consequently, no estimate of depth to the salt can be made. The length of shots would, in any event, serve only to detect salt at depths less than 4,500 feet.

Geophysical investigation further indicates that the Orange dome is the peak of a very pronounced subsurface structure that may extend considerably beyond the limits of the present oil-producing area. Unlike many of the piercement-type domes, in which the salt sides are nearly vertical or have only scant inclination with consequent deformation of the adjacent beds limited to short distances (rarely more than ½ mile laterally from the sides of the salt), the Orange structure has only a very gentle inclination from the peak, and the deformation effects are noticeable for considerable distances beyond the limits of the present oil-producing area. Particularly is this

TEXAS-LOUISIANA GULF COAST GEOLOGIC SECTION

Series	*Group*			*Formation*	*Conroe District*	*Pettus District*
Pleistocene				Beaumont Lissie Reynosa		
Pliocene-Miocene				Fleming		
Oligocene	Upper			Catahoula		
	Middle			*Discorbis* *Heterostegina* *Marginulina*		
	Lower			Frio Vicksburg		
Eocene	Jackson			Whittsett* McElroy (*T. Hockleyensis*) Caddell (*T. Dibollensis*)		
	Claiborne	Upper	Yegua	Cockfield	"Upper Cockfield" gas sand	Pettus sand
					Conroe sand	Tuleta or "Yegua sand" 170 feet below Pettus sand
				Upper Saline Bayou		
				Lower Saline Bayou		
		Lower	Cook Mountain	Milams Crockett Sparta		
			Mount Selman	Weches Queen City Reklaw Cane River (not everywhere present) Carrizo		
	Wilcox			Wilcox		

* The Jackson group of formations is classified according to a recent paper by Miss Alva C. Ellisor, "Jackson Group of Formations with Notes on Frio and Vicksburg," *Bull. Amer. Assoc. Petrol. Geol.*, Vol. 17, No. 11 (November, 1933), pp. 1293–1350. Following Miss Ellisor, the name Fayette is abandoned and Whitsett is substituted.

true of the north-side slope—it is slightly less pronounced on the south side.

STRATIGRAPHY

The stratigraphic section (Fig. 4) recorded by the drill in the Orange field shows the normal Gulf coastal sedimentary series consisting of alternating vari-colored clays, shales, sandy clays, sands, and sandstones. The accompanying correlation table shows the normal section of Gulf Coast formations. The driller's log is the only means by which the contacts of the upper formations can be determined.

The Pleistocene formations extend down to a depth of approximately 1,150 feet in the center of the field. This series consists mainly of bluish and greenish clays and sands. The sand beds are more abundant in the lower part and usually contain gravel layers.

The Pliocene-Miocene series, representing non-marine, lagoonal, and, in its basal part, shallow marine deposits, consists of light-to-dark greenish gray and reddish clays and shales with numerous intercalations of light gray and tan sand beds. A bed of reddish clay at approximately 4,000 feet has been used for local correlation. However, no reliable faunal and lithologic markers which would permit correlation with the several divisions of the Miocene-Pliocene recognized at the outcrop, are found in this section. The base of the Catahoula formation is placed at approximately 5,300 feet in the center of the field. This base is considerably higher in the southern part of the field.

The sedimentary section below the Catahoula formation consists predominantly of dark shales and sandy shales of marine origin. It contains the well known *Discorbis* and *Heterostegina* faunal zones. Within the *Heterostegina* zone is a sandy phase which seems to be correlative with the *Heterostegina* sands up the dip. The *Marginulina* sand of the *Marginulina* zone, a third faunal zone ordinarily distinguished in the Gulf Coast section, and a prolific producing sand in several Gulf Coast fields, has not been recorded in any of the wells drilled.

The deepest well in the field, the Gulf Production Company's Hager Moore No. 12 (total depth 6,399 feet) was drilled more than 1,000 feet into the *Discorbis-Heterostegina* shale section and stopped in the Vicksburg (on the basis of fossils). Difficulties in drilling through the basal part of this Oligocene shale section were experienced in several wells, due to "heaving," which caused the abandonment of the wells.[3] The heaving character of this lower shale likewise confirms

[3] Heaving shale was reported in the Amerada (Rycade) State No. E-13, in the Gulf Production Company's Boyles No. 3, and in other wells. See the tabulated list of wells, Table II.

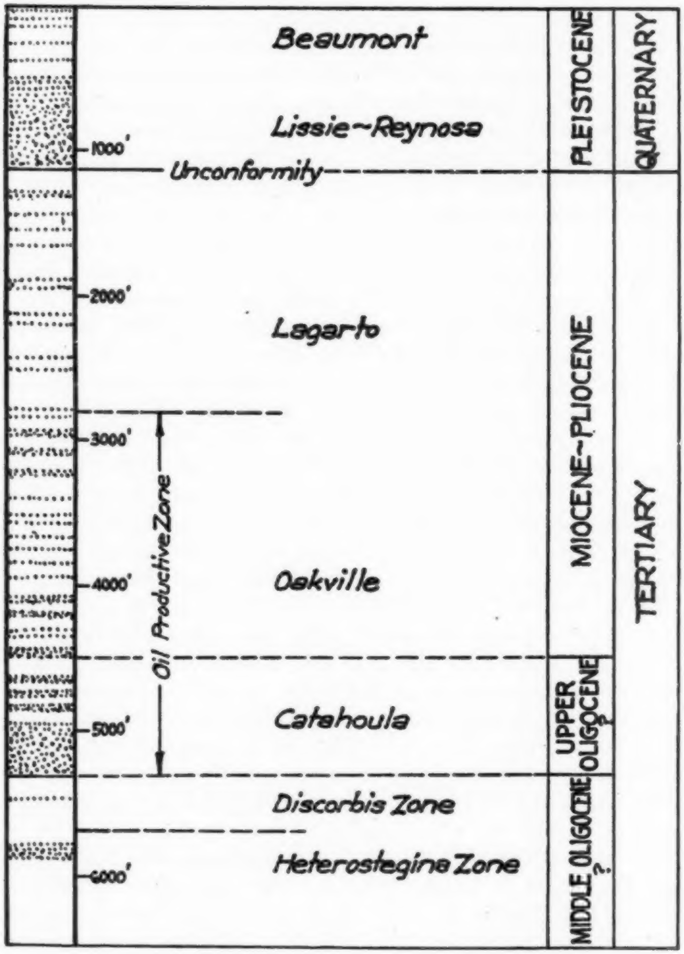


FIG. 4.—Generalized stratigraphic section of Orange field, Orange County, Texas. Depths shown in feet.

the presence of Vicksburg, in which formation these heaving shales commonly abound.

UNCONFORMITY IN CENTRAL AREA

It is apparent, therefore, that in the central part of the dome an important and pronounced unconformity is present where the *Heterostegina* formation rests directly on top of the Vicksburg, with most, if not all, of the *Marginulina* formation and all of the Frio section missing—sediments which approximate 2,000 feet in thickness in near-by and adjacent areas (Fig. 5).

This incomplete and short section is, of course, a characteristic feature of these deep domes of the Orange type—structures which have become of increasing importance from the standpoint of oil production in the Gulf Coast during the past 4 years.

The evidence on the basis of this unconformity is plain: that during *Marginulina*-Frio time (early Oligocene) this structure was sufficiently active (vertical growth of the salt stock was in progress) to elevate the Vicksburg sidements above the level of the sea in the form of an island; that during this time these beds were subjected to erosion; that they remained above sea-level during all of Frio and *Marginulina* time; and that the present area of the Orange field was not again submerged until the beginning of *Heterostegina* time in the Middle Oligocene.

STRUCTURE

Due to the lack of reliable markers in the Miocene formation, it is difficult to correlate various wells. Different oil zones may be distinguished. It was also observed, however, that in many places offsets to oil wells produced salt water at the same depth and apparently from the same sand. The Orange oil field is noted for such occurrences, and a satisfactory explanation for this condition has not been offered. In the earlier days these erratic conditions were explained by lenticular sand conditions.

At present, oil fields are being exploited with greater precision and with much better subsurface control. This control has lately been vastly improved by the introduction of electrical logs. It is now known that most deep salt domes of the Orange type are faulted, and that these faults usually act as barriers, causing the oil reservoir to be divided into several blocks, each with its own separate gas, oil, and water levels.[4] Such a condition would fully explain the outstanding irregularities encountered in the Orange oil field.

[4] E. W. K. Andrau, "Electrical Prospecting," *Oil and Gas Jour.* (April 4, 1935).

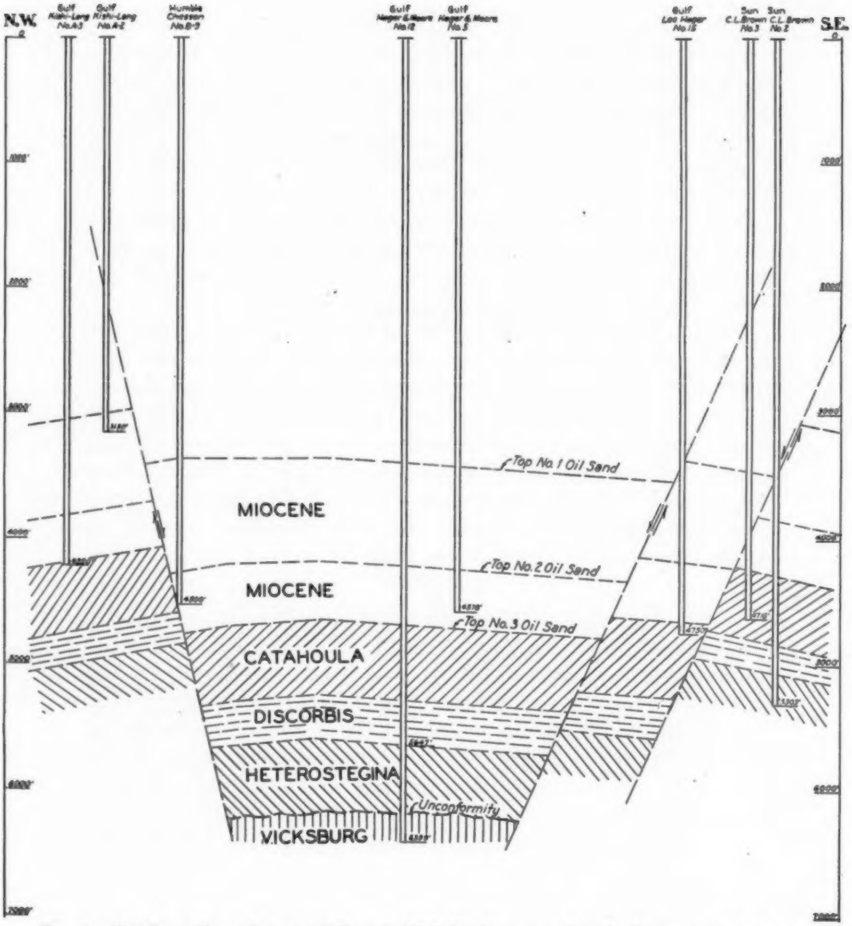


FIG. 5.—North-south section across Orange field, showing unconformity between *Heterostegina* and Vicksburg in central part. Depths shown in feet.

STRUCTURE AS SHOWN BY MIOCENE

Considering the speed with which drilling was done in the boom years of 1921 and 1922, it is not surprising that only one marker bed, with which to determine the existence of faults, can be recognized. This bed is in the Miocene and is the No. 1 sand and shale group—the first main group of oil sands in the center of the field. This group usually consists, as illustrated by the Gulf Production Company's Hager-Moore No. 3, of five oil sands (Fig. 6). The total thickness is approximately 300 feet, composed of alternating sands and shales. In the Hager-Moore well No. 3, the five oil sands encountered were drained through four different screen settings. This No. 1 sand occurs in the center of the field at a depth of approximately 3,400 feet. It is found at a much higher level in the north part of the field.

In Kishi-Lang No. A-3, the top of the No. 1 oil sand occurs at a depth of 3,050 feet, and is correlated with the first oil sand at a depth of 3,000 feet in the Gulf Production Company's Kishi-Lang No. A-2 (Fig. 6). In Kishi-Lang wells No. A-2 and No. A-3, the Gulf Production Company, instead of using different screen settings for each sand, set one screen, taking in the entire section with blank pipe opposite the shale "breaks."

In the Humble Oil and Refining Company's Chesson No. B-9, the top of the No. 1 oil sand was encountered at 3,379 feet. This well is 600 feet southeast of the Gulf Production Company's Kishi-Lang No. A-2, where the No. 1 oil sand was found at the depth of 3,000 feet, indicating that a fault lies between these two wells, with a throw of 350 feet or more (section, Fig. 6).

The No. 1 oil sand is overlain by 600 feet of formation, which is mostly shale, the top of which may be correlated with the top of the Oakville. This shale group is overlain by a sandy section, which represents the down-dip facies of the Lagarto (Fleming) beds lying at the surface. The base of this upper sand section, in the central part of the field, is found at 2,800 feet in the Humble Oil and Refining Company's Chesson No. B-9, and the same contact may be recognized at 2,530 feet in the Gulf Production Company's Kishi-Lang No. A-3. In the Gulf Production Company's Kishi-Lang No. A-2, this upper sand section extends down to 2,620 feet, and at this point a fault is postulated (section, Fig. 6).

In the lower part of the Miocene, below the No. 1 oil sand group, numerous sand beds are reported by the driller. A differentiation between sand and shale groups in the Lower Miocene is not possible, but it may be observed that the important shale zone (the Middle Oligocene green shales) is not recorded by the driller in the center of the

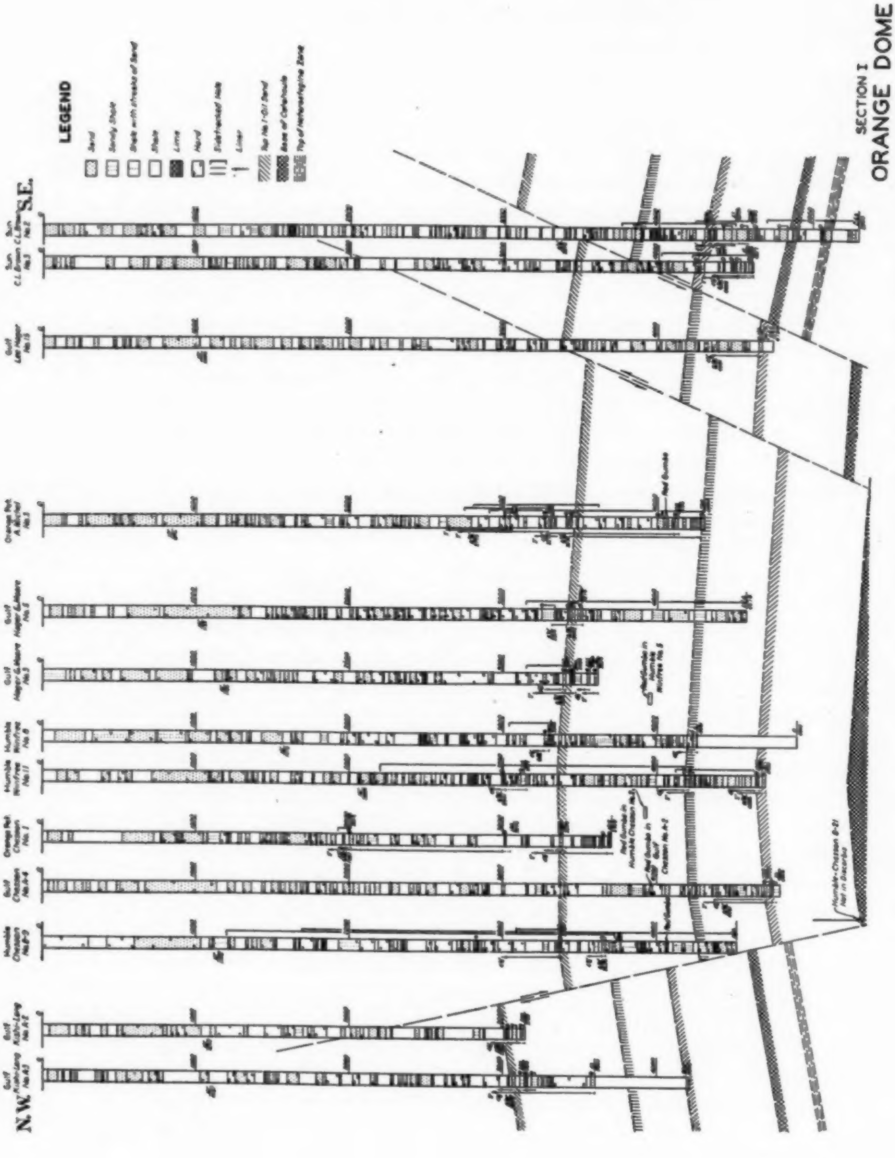
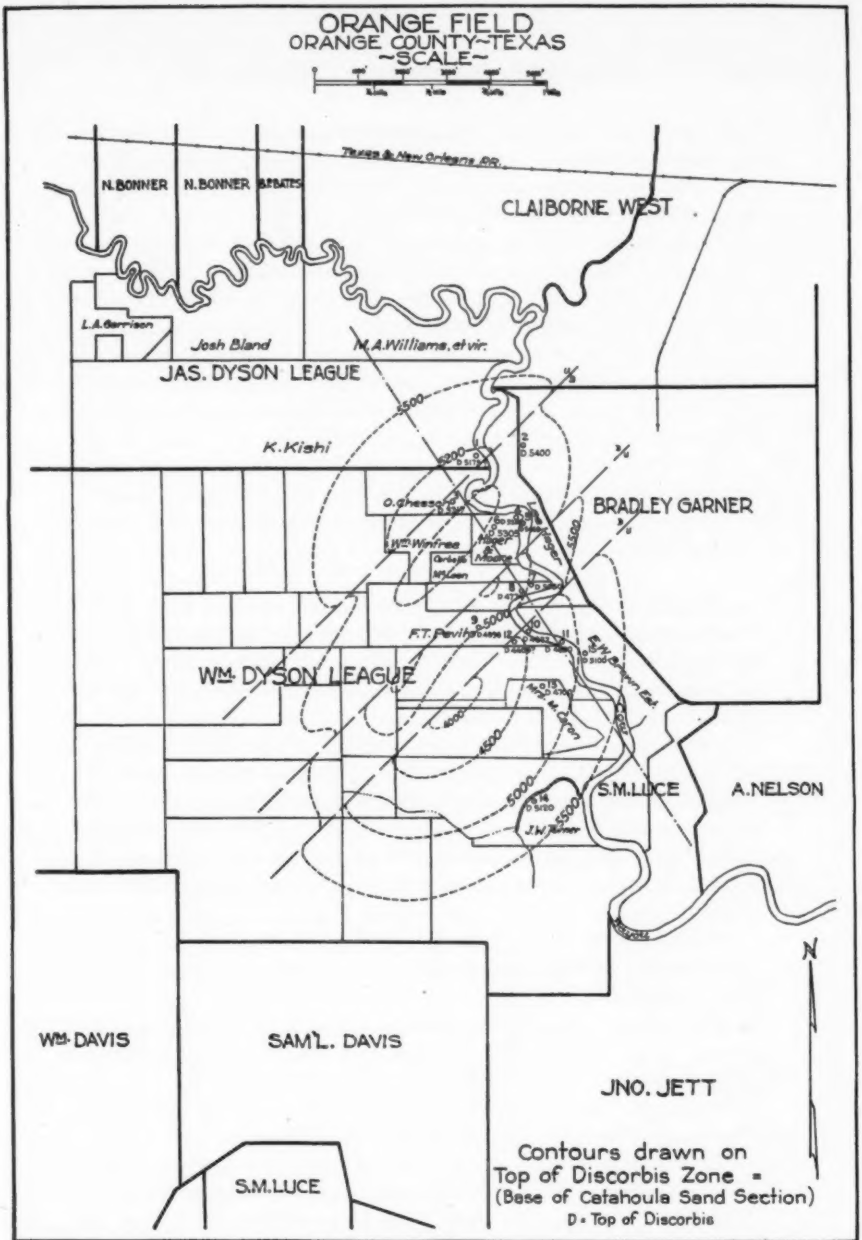


FIG. 6.—Section, Orange dome. Depth shown in feet. Vertical and horizontal scale the same.



1-Gulf-Kishi-Lang-B-4-D-5175?
2-Sun-Johnson-1-D.5400
3-Continental-Chesson 13-D.5317
4-Sun-Gunstream 5-D.5358
5-Rycade-State A-5-D.5468
6-Gulf-Hager Moore 12-D.5305
7-Gulf-Boyles 3-D.5050
8-Gulf-Boyles 2-D.4774
9-Gulf-Pevito 11-D.4998
10-Rycade-State E-13-D.4677
11-Rycade-State E-2-D.4800
12-Gulf-Pevito 10-D.4677
13-Humble-Caron 1-D.4700
14-Sinclair-Turnex 1-D.5120
15-Sun-Brown 6-D.5100

—·—·—Line of Section shown on Figure 6.

FIG. 7.—Structure map of Orange field with contours on top of *Discorbis* zone shown in feet. Location of the several faults together with central graben is shown.

field. Paleontological information confirms this evidence based on drillers' logs. One of the deepest wells in the downthrown block (section, Fig. 6), the Humble Oil and Refining Company's Chesson No. B-21, did not reach the *Discorbis* zone at 5,300 feet.

Only normal faulting has been found in Gulf Coast salt domes. The hade of the northern fault, as shown in the section of Figure 6, is known to be very steep, since the Humble Oil and Refining Company's Chesson No. B-21 is not in the *Discorbis* zone at 5,300 feet, and the Gulf Production Company's Kishi-Lang No. A-2 is known to be in the northern upthrown block above 3,000 feet. Likewise, it may be inferred that the trend of the fault is southwest and northeast, nearly perpendicular to the line of the section in Figure 7.

The No. 1 sand group is not productive in the southeastern part of the field. Another normal fault is indicated here, but the evidence for this is based, not on Miocene correlation, but on Oligocene correlation.

STRUCTURE AS SHOWN BY OLIGOCENE

Oligocene formations were encountered at relatively high levels in the southeastern part of the field. Some doubt exists about the top of the *Discorbis* zone, which has been placed as high as 4,677 feet in the Rycade Oil Company's E-13, and 4,409 feet (tentatively) in the Gulf Production Company's Pevito No. 10.

In the Sun Oil Company's Brown No. 2 is a sand section with an oil showing at the top, 400 feet below the base of the Catahoula. The description and stratigraphic position suggest that this bed marks the top of the *Heterostegina* zone (section, Fig. 6). With the *Discorbis* as high as 4,677 feet in the southeastern part of the field, and as deep as 5,300 feet in the central part, it may be inferred that a major fault exists in this southeastern part (section, Fig. 6, and map, Fig. 7).

This southern fault dips northwest, compensating the one in the northern part of the field, and has a throw of approximately 600 feet (Figs. 6 and 7).

This study of the Orange field discloses the presence of a central graben—a feature which is an almost invariable accompaniment of these deep structures—as shown by detailed study within the past several years. Similar central grabens have been recognized at Conroe, Thompsons, Manvel, Raccoon Bend, and Anahuac.

It is also interesting to note in this connection that the Sinclair Oil and Refining Company's Turner No. 1, the most southern well drilled, situated approximately 3,700 feet south of the nearest producing well, encountered the *Discorbis* zone at a depth of 5,120 feet.

This seems to indicate that the Orange structure may extend a considerable distance south and southwest from the present limits of production.

A section extending from the San Augustine-Jasper County line across Jasper and Orange counties and through the Orange field—to show the features of the regional structure—is shown in Figure 8. The surfaces—the top of *Heterostegina* and the top of *Hockleyensis*—shown in the section are based on paleontologic data secured from the several wells included in the line of the section.

MISCELLANEOUS FACTS

Development of the field to date, as recorded in Table II, has disclosed some unusual features.

Water has given a great deal of trouble. Wells have come in making a good flow of oil, only to be shortly drowned by water.

Many wells offsetting good oil wells have come in as water wells at apparently the same depth.

Numerous blow-outs and high gas pressures have characterized the development—these phenomena likewise appearing in widely separated places.

The wells with large initial production, commonly sanded up and, after reconditioning, were only small producers. Much fine sand, very difficult to screen, occurs in various parts of the field, and at different levels. This sanding-up taught Gulf Coast operators for the first time that a back pressure must be used in flowing wells and that they could not be flowed wide open without danger of destroying them.

Due to these various factors, long-lived wells have been the exception in the field, and much redrilling and much reworking have been required.

Oil in the Orange field is dark brown in color, 23°–24° Bè. in gravity, and high in lubricating stock—Grade A oil of the Gulf Coast.

The total productive area of the field includes 400 acres.

The total oil production to January 1, 1936, is 29,761,198, barrels (Fig. 9).

The oil recovery per acre to July 1, 1935, is 79,180 barrels.

The total number of wells drilled to July 1, 1935, is 424.

The total number of producing wells completed to July 1, 1935, is 318.

The average oil well has produced, to July 1, 1935, 99,600 barrels.

The average depth of the wells drilled is 4,000 feet.

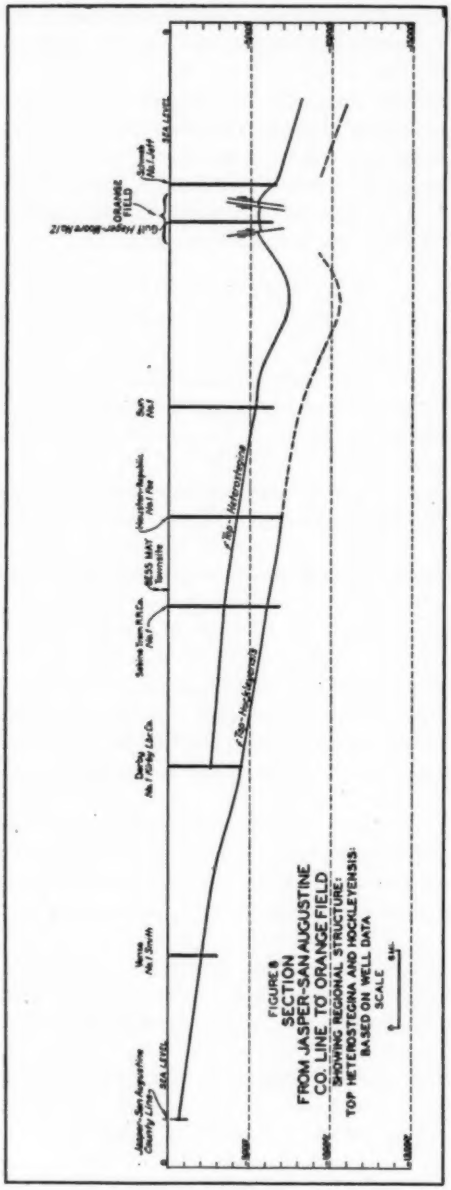


FIG. 8.—Section from Jasper-San Augustine County line across Jasper and Orange counties, through Orange field, showing regional structure. Depths shown in feet.

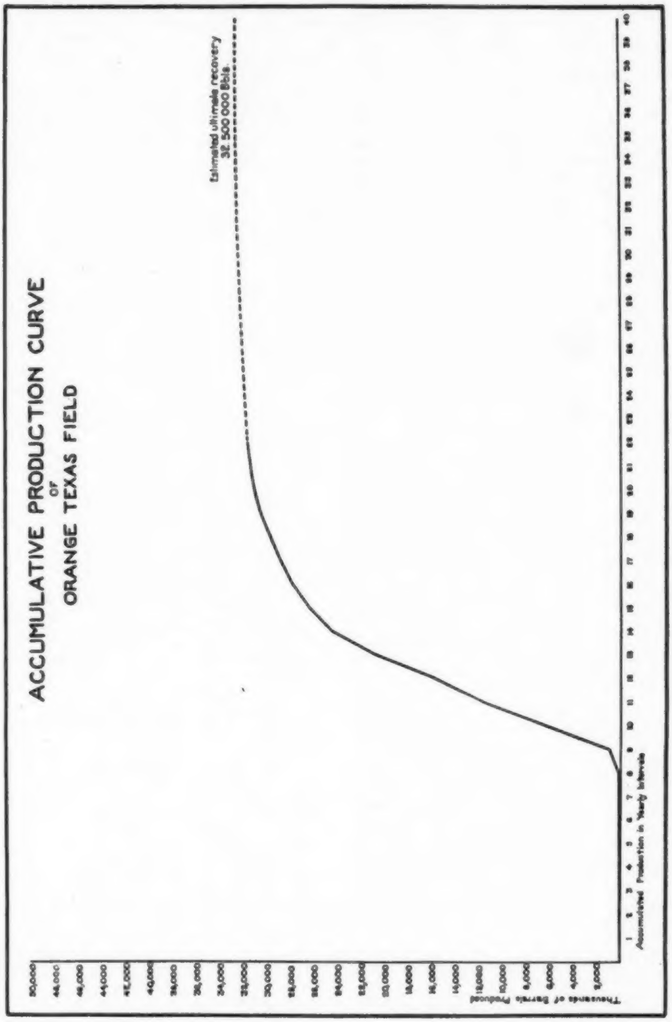


FIG. 9.—Accumulative production curve of Orange, Texas, field.

TABLE II

Wells in Orange Field, March 1, 1932*

Operator and Lease	Well No.	Date Completed	I.P. Barrels	T.D. Feet 1st Comp.	Number W.O.	Highest I.P. Bbls.	Greatest T.D. Feet	Remarks
Amerada								
Granger	1	6- 6-22	1,000	3,296	1	1,000	4,266	90% B.S. & W.
Kishi-Lang	1	1-14-22	300	3,300	1	300	3,300	75% B.S. & W. Formerly Sabine Oil Co.
Kishi-Lang	2	4-29-22	1,000	3,150	2	2,250	3,676	D. & A.
Kishi-Lang	3							
Kishi-Lang	4	8- 1-22	40	4,324	2	40	4,324	D. & A.
State	A-1	8-20-22	300	3,295	2	300	3,320	P.L.O. Heavy gas pressure.
State	A-2	3-12-23	250	3,320	1	250	5,009	Pumping
State	A-3	6-25-24		4,819			4,819	D. & A.
State	A-5	7-17-25		5,850			5,850	D. & A.
State	A-6	8-18-23	2,000	3,540	1	2,000	4,224	
State	B-1	4-29-22	1,200	2,930	2	1,200	3,888	
State	B-2	6-12-22	4,200	3,414	3	6,000	4,835	P.L.O.
State	B-3	1-15-23	200	3,909		200	3,909	
State	B-4	7-16-26	200	3,892		200	3,892	
State	B-5	7-16-26	120	3,375	1	1,500	4,236	
State	B-6	4-16-26	600	4,640		600	4,640	
State	B-10	6-23-23	351	3,392	1	3,500	3,473	
State	B-11	3-26-26	540	4,650	1	2,000	4,650	P.L.O.
State	B-12	8-11-27						Abandoned.
State	B-13	3-16-26	1,500	4,652		1,500	4,652	
State	B-14	1-15-26	3,300	4,633	1	3,300	4,633	
State	C-1				2		4,850	
State	C-2	10-27-23	800	3,893	4	2,500	4,860	90% B.S. & W.
State	E-1	5- 3-24	3,600	4,550	1	3,600	5,040	D. & A.
State	E-2	8- 7-24	360	4,995		360	4,995	
State	E-3							
State	E-4	7-30-24	2,000	4,605		2,000	4,605	P.L.O.
State	E-5	7-25-24	2,850	4,550		2,850	4,550	
State	E-8	1- 2-25	3,000	4,915		3,000	4,915	P.L.O.
State	E-13	7-16-24	2,400	4,548	1	2,400	5,687	Abnd. (Heaving Sh.)
State	E-14	2-17-25		5,315			5,315	D. & A.
American Natl. Oil Co.								
Winfree	1	2-13-25		4,675			4,675	D. & A.
Atlantic Oil Prod. Co.								
Hager & Moore	1	3- 9-22	250	4,172	1	250	4,172	10% B.S. & W.
Hager & Moore	2	3-13-22	10,000	3,577	3	10,000	3,577	Decreased within few days to 1,200 bbls. 14% B.S. & W. Then sanded up.
Hager & Moore	3	5-20-22	300	3,310	4	650	3,517	
Hager & Moore	4	4-15-22	1,000	3,580	3	1,000	3,700	
Hager & Moore	5	5-16-22	1,200	3,583		1,200	3,583	
Moore	1	Dec. 1921	1,200	3,200		1,200	3,200	
Moore	2	2- 4-22	250	3,170	1	250	3,356	D. & A.
Moore	3	Apr., 1922	1,000	3,150	1	1,000	3,346	Flowed by heads.
Moore	4	July, 1922	20	3,315	2	125	3,365	Tstd. at 3,310 ft. No oil.
Moore	5							
Moore	6							
F. T. Pevito	1	3-16-26	100	3,353		100	3,353	10% B.S. & W.
L. C. Barrett								
Winfree	1							
Beck Petr. Co.								
Kishi	1	Feb., 1918		3,390			3,390	Abandoned.
Big Marie Oil Co.								
Turner	1	Apr., 1922		1,515			1,515	D. & A.
Bland Oil Co.								
Bland	1	Oct., 1917	35	3,090		35	3,090	Abnd. Now H.O. & R. Co.
Brown Oil Co.								
Luce	1	Feb., 1920		3,500			3,500	Orig. Gambler Oil Co. D. & A.
Brown-Babbette Oil Co.								
E. W. Brown	1							Started 7-9-26. Wildcat 2½ miles from center of field. Attempt to extend production to southeast.

* B.S. & W.—Basic sediment and water.
D.A.—Dry and abandoned.
P.L.O.—Pipeline oil.
I.P.—Initial production.
S.W.—Salt water.
T.A.—Temporarily abandoned.
W.O.—Workover.

WELLS IN ORANGE FIELD (*Continued*)

Operator and Lease	*Well No.*	*Date Completed*	*I.P. Barrels*	*T.D. Feet 1st Comp.*	*Number W.O.*	*Highest I.P. Bbls.*	*Greatest T.D. Feet*	*Remarks*
E. W. Brown Est.	1	3-22-24	900	4,575		900	4,575	
E. W. Brown Est.	2	7-25-24	240	4,700	1	240	5,776	Abandoned
E. W. Brown Est.	3	7-25-24	250	4,625	2	250	4,968	
E. W. Brown Est.	4				1		4,150	D. & A.
McLean	1	Oct., 1921	3,500	3,321	4	3,500	3,321	
McLean	2	2- 4-22	700	3,945	5	700	3,945	80% B.S. & W.
McLean	3	3-30-22		3,180	5	1,500	4,039	P.L.O. I.P. not given.
McLean	4		No oil	2,295	7	1,000	4,075	Dry gas. 1st. Comp. D. & A.
McLean	5	8- 5-22	No oil	2,678	8	450	5,740	
McLean	6	6-22-22		3,340	6	2,500	3,570	I.P. not given.
McLean	7	7-10-22	50	3,484	5	1,200	3,660	
McLean	8	5-12-23	350	4,080	5	350	4,085	
McLean	9	5-12-23	125	3,150	3	1,200	3,600	
McLean	10							
McLean	11							
McLean	12	7-29-26	800	3,600	3	800	4,028	80% B.S. & W.
Pevito	1	5- 1-21	150	2,748	2	150	3,186	
Pevito	2	8- 6-21	1,500	3,227	2	1,500	3,250	SW. Abandoned
Pevito	3	Apr., 1922	50	3,193		50	3,193	8% B.S. & W.
Pevito	4	5-27-22		3,260	1		3,420	D. & A.
Pevito	5	7-29-22	180	3,190		180	3,190	
Smith-Foreman	1	May, 1929		4,510			4,510	D. & A.
Cameron-Andrews								
State	1							
State	2				2		3,955	
Carter-Jewitt Oil Co.								
Mary Williams	1	7-22-22		3,575			3,575	Dry. Orig. Elinor Oil Co.
Terrill	1	5-19-22		3,410			3,410	D. & A.
Cross Streams Devl. Co.								
Chambers	1	Dec., 1920		3,425			3,425	D. & A.
Crews Oil Co.								
Mansfield	1	5-29-31		1,412			1,412	D. & A.
Continental Oil Co.								
Chesson	1	Mch., 1920	50	1,760	3	1,500	4,200	Prev. Humble, Hamilton, and Mutual
Chesson	2	9- 2-22	775	4,075	3	775	4,075	Prev. Hamilton & Mutual.
Chesson	3	Mch., 1921	130	2,036	2	3,900	4,760	Prev. Little Six, Hamilton, & Mutual.
Chesson	4	6-21-22	2,500	4,085	2	2,500	4,705	Prev. Texhoma & Hamilton, 65% B.S. & W. D. & A.
Chesson	5	3-24-23	900	4,260	2	900	4,260	D. & A.
Chesson	6	7-29-22	800	4,010	4	1,000	4,673	Prev. Texhoma, Mutual, & Hamilton.
Chesson	7	8-12-22	2,880	3,950	4	2,880	4,650	Prev. Texhoma, Mutual, & Hamilton.
Chesson	8	6-17-22	5,000	3,900	4	5,000	3,900	Prev. Texhoma, Mutual, & Hamilton.
Chesson	9	5- 3-24	175	2,910	2	175	4,880	Prev. Texhoma, Hamilton, & Mutual. D. & A.
Chesson	10	9- 2-22	765	3,200	2	2,500	4,760	Prev. Texhoma, Mutual, & Hamilton.
Chesson	11	2-24-23	700	3,000	2	700	3,375	Prev. Mutual & Hamilton.
Chesson	12	5- 5-23	40	2,690	1	550	3,160	Prev. Mutual.
Chesson	13	10- 3-24	4,200	4,650	3	4,200	5,625	Prev. Texhoma & Mutual.
Chesson	14	7-31-25	2,400	4,600	2	2,400	4,750	Prev. Mutual & Texhoma. 44% B.S. & W.
Chesson	15	8-14-25	142	3,095	1	142	4,700	Prev. Texhoma D. & A.
Chesson	16	10-20-23		3,075	7	220	4,625	Prev. Texhoma & Mutual. D. & A.
Cow Bayou Oil Co.								
State	1	1- 7-22		2,810			2,810	D. & A.
S. W. Dennis								
LeFlore	1	6- 1-22		3,200±			3,200±	Prev. Port Arthur Oil Co. D. & A.
Edgerly Oil Co.								
Cormier	1	7-10-25	50	3,100		50	3,100	
Emerson & Moore Oil Co.								
Jackson	1	4-29-22	1,500	4,000		1,500	4,000	Taken over by Supreme Oil Co.
Eureka Oil Co.								
Geo. Bland	1	3-11-22		150±			150±	D. & A.
Farish, Watts & Collins								
McGuire	1	Aug., 1922		3,200			3,200	D. & A.
W. B. Flynn								
Mecom	1	4-21-22		3,355			3,355	D. & A.

WELLS IN ORANGE FIELD (*Continued*)

Operator and Lease	*Well No.*	*Date Completed*	*I.P. Barrels*	*T.D. Feet 1st Comp.*	*Number W.O.*	*Highest I.P. Bbls.*	*Greatest T.D. Feet*	*Remarks*
Godchaux Oil Co.								
Turner	1							
Great Southern Oil Co.								
Bland	1	2-24-28		3,140			3,140	D. & A.
Guffey Petr. Co.								
Miller & Link	1	1907		2,000			2,000	D. & A.
Gulf Coast Oil Co.								
Leon	1	1-28-22	500	3,190	1	500	3,190	D. & A.
Leon	2	3-25-22	10,000	3,170	1	10,000	3,170	
Leon & Moore	1	Jan., 1922	500	3,350		500	3,350	
Leon & Moore	2	3-10-22	10,000	3,170		10,000	3,170	Now Sinclair Oil Co.
Leon & Moore	3	8-12-22	200	3,550	1	200	3,550	Now Sinclair Oil Co.
Leon & Moore	4							
Leon & Moore	5	8-12-22		3,555	3	104	3,555	Small Producer.
Gulf Production Co.								
Boyles et al.	3	9- 6-25		5,421			5,421	Abnd. Heaving sh.
Briggs & Moore	1	2- 9-22		3,870			3,870	SW.T.A.
Briggs & Moore	2	2-25-22	200	3,600	3	2,775	3,600	
Briggs & Moore	3	8- 1-22	800	3,415		800	3,415	10% B.S. & W.
Briggs & Moore	4	2-17-23	75	3,570		75	3,570	
Briggs & Moore	5							
Briggs & Moore	6	6-24-22		3,150			3,150	Small Producer.
Carrie Brown	1	9-18-22		4,612			4,612	D. & A.
Chesson	A-1	3- 2-22	6,500	3,850	2	6,500	4,600	8% B.S. & W.
Chesson	A-2	5-13-22	800	3,635	1	4,000	3,732	
Chesson	A-3	3-18-22	3,000	4,279	2	3,000	4,625	50% water in few days.
Chesson	A-4	4-14-25	150	4,806		150	4,806	
Oscar Chesson	1	2-17-22	2,500	4,046	1	2,500	4,046	30% B.S. & W.
Oscar Chesson	2	1-24-22	2,500	4,011	4	2,500	4,625	Increased to 3,500 bbls.
Oscar Chesson	3	5- 6-22	100	3,366	3	800	4,430	
Oscar Chesson	4	5-29-22	1,200	3,338	4	1,200	3,573	
Oscar Chesson	5	6-22-23	4,086	3,518	1	4,086	3,518	
Oscar Chesson	6	2-22-23	300	3,519	1	950	3,865	
Oscar Chesson	7	4-22-24	450	3,577		450	3,577	
Oscar Chesson	8	9-14-25	2,500	4,442	1	2,500	4,442	20% B.S. & W. D. & A.
M. Granger	1	12-12-24	2,400	4,490	3	2,400	4,615	D. & A.
M. Granger	2	4-24-25	2,200	4,500	1	2,500	4,560	
M. Granger	3	4-22-27	1,300	4,409		1,300	5,968	4% B.S. & W.
M. Granger	4	4-19-27		5,000			5,000	D. & A.
L. T. Grubbs	1	2-24-23	200	2,600	1	600	3,170	
L. T. Grubbs	2	4- 7-23	100	2,700	1	300	3,150	
Hager & Moore	1	12-31-21	100	3,369	2	200	3,600	
Hager & Moore	2	1- 3-22		3,560			3,560	D. & A.
Hager & Moore	3	3- 4-22	300	3,500	3	650	3,614	
Hager & Moore	4	4- 6-22	3,000	4,093	2	3,000	4,144	
Hager & Moore	5	7-27-22		4,579			4,579	D. & A.
Hager & Moore	6	7- 2-22	250	3,352	3	3,000	4,676	
Hager & Moore	7	9-15-22	400	3,353	4	1,250	4,217	
Hater & Moore	8	12-23-22	200	3,315	1	200	3,500	
Hager & Moore	9	1-15-23	50	3,359	1	200	3,519	10% B.S. & W.
Hager & Moore	10	7-27-23	3,000	3,531	1	3,000	3,531	
Hager & Moore	11	9-26-24		4,200	1		4,340	D. & A.
Hager & Moore	12	12-26-30	744	3,901		744	3,901†	
Lee Hager Fee	1	4-13-22	2,000	3,472		2,000	3,472	
Lee Hager Fee	2	3-29-22	3,500	3,950	4	3,500	4,627	10% B.S. & W.
Lee Hager Fee	3	7- 9-22	500	4,229	5	500	4,644	60% B.S. & W.
Lee Hager Fee	4	6- 6-22	1,200	3,338	4	2,100	4,200	
Lee Hager Fee	5	7-16-22	200	3,390	1	500	4,650	
Lee Hager Fee	6	8-14-22	125	3,482	1	125	3,482	
Lee Hager Fee	7	10-28-22	175	4,656	4	316	4,656	
Lee Hager Fee	8	9- 9-22	425	3,360	2	1,500	4,620	55% B.S. & W.
Lee Hager Fee	9	12-15-22	200	3,312		200	3,312	
Lee Hager Fee	10	1-26-23		1,126			1,126	D. & A.
Lee Hager Fee	11	7-21-23		3,401	1	2,000	3,933	I.P. not given
Lee Hager Fee	12	6-10-23	125	3,306	2	125	3,550	6% B.S. & W.
Lee Hager Fee	13	5- 5-24	650	3,495	1	650	5,745	
Lee Hager Fee	14	1-22-24	1,200	4,031	1	2,000	4,680	4% B.S. & W.
Lee Hager Fee	15	6-26-24	150	4,679	1	150	4,785	D. & A.
Lee Hager Fee	16	8-29-24	150	3,555		150	3,555	
Lee Hager Fee	17	4-12-25	316	4,056		316	4,056	
Lee Hager Fee	18	12-18-25	1,800	4,650	1	1,800	4,650	

† This well was deepened in 1934 to 6,399 feet. No oil sands were found at the lower depths and it was abandoned as a dry hole on January 24, 1934, in the Vicksburg. Top of *Discorbis*, 5,305; top *Heterostegina*, 5,647; *Marginulina*, not recorded. Bottom of hole in Vicksburg.

WELLS IN ORANGE FIELD (*Continued*)

Operator and Lease	Well No.	Date Completed	I.P. Barrels	T.D. Feet 1st Comp.	Number W.O.	Highest I.P. Bbls.	Greatest T.D. Feet	Remarks
Lee Hager Fee	19	12-18-25	3,200	4,660	2	3,200	4,660	
Lee Hager Fee	20	2-26-26	900	4,600	2	1,000	4,644	
Lee Hager Fee	21	5- 7-26	38	4,830	1	38	4,830	D. & A.
Lee Hager Fee	22	5-28-26	155	4,650		155	4,650	
Lee Hager Fee	23	7-23-26		4,625			4,625	D. & A.
Lee Hager Fee	24	8-12-26						D. & A.
Hammon Consolidated	1	8- 8-24		4,650			4,650	D. & A.
Hammon Consolidated	2	3-13-25		5,118	1		5,415	D. & A.
Hammon Consolidated	3							
Kishi-Lang	A-1	Dec., 1920	No oil		5	325	3,961	
Kishi-Lang	A-2	5- 2-21	500	3,150	1	500	3,175	
Kishi-Lang	A-3	4- 8-22	900	4,200	2	900	4,200	
Kishi-Lang	A-4	6- 7-23	100	4,390		100	4,390	
Kishi-Lang	A-5	9-27-23		3,311			3,311	
Kishi-Lang	A-6	2-16-24	1,750	4,117		1,750	4,117	
Kishi-Lang	A-7	3-28-23	125	3,053	2	800	4,125	
Kishi-Lang	A-8	11-27-24	600	5,081		600	5,081	50% B.S. & W.
Kishi-Lang	A-9	3-14-25	2,500	3,193		2,500	3,193	40% B.S. & W.
Kishi-Lang	A-10							
Kishi-Lang	A-11	7-29-26	208	4,625		208	4,625	80% B.S. & W. Flowing.
Kishi-Lang	B-1	3-25-22	2,500	3,940		2,500	3,940	50% B.S. & W.
Kishi-Lang	B-2	3- 4-22	2,000	3,900	2	2,000	4,625	
Kishi-Lang	B-3	5-20-21	100	3,184	4	1,500	4,270	
Kishi-Lang	B-4	8-25-22		5,483			5,483	T.A.
Kishi-Lang	B-5	3-15-22		4,302	1	50	4,302	T.A. then W.O.
Kishi-Lang	B-6							
Kishi-Lang	B-7	4- 7-23	150	3,050		150	3,050	45% B.S. & W.
Kishi-Lang	B-8	3- 5-26	1,600	4,631	1	1,600	4,631	P.L.O. Gr. 27.9.
Kishi-Lang	B-9	5- 7-26	1,800	4,629		1,800	4,629	P.L.O.
Leason	1	6-21-24	137	3,175		137	3,175	
McCall	1	9- 8-23		4,400			4,400	D. & A.
McGuire	1	12-17-22	125	3,336	1	125	3,474	D. & A.
McGuire	2							
Pevito	1	5-20-22		3,275	1		3,599	Small producer. SW.
Pevito	2	8-12-22	200	3,350	2	300	3,534	
Pevito	3	3-26-23	800	3,178	1	800	4,089	D. & A.
Pevito	4	6-30-23	800	3,400	3	800	4,852	D. & A.
Pevito	5	3- 6-24	2,200	4,636	1	2,200	5,200	D. & A. 75% B.S. & W.
Pevito	6	4-27-24	400	3,413	1	400	3,413	45% B.S. & W.
Pevito	7	7-11-24	100	4,580		100	4,580	
Pevito	8	2-12-25	160	4,569		160	4,569	4% B.S. & W.
Pevito	9	7-10-25	2,900	4,549	1	2,900	4,600	10% B.S. & W.
Pevito	10	8-20-25		5,000			5,000	D. & A.
Pevito	11	6-10-27	280	4,700	1	280	5,220	D. & A.
Pevito	12	6-18-28		4,823			4,823	D. & A.
Winfree Fee	A-1	12- 4-21	4,100	3,400	2	4,100	3,582	
Winfree Fee	A-2	Apr., 1922	100	4,598	2	100	4,598	
Winfree Fee	A-3	3-18-22	500	4,132	2	500	4,132	
Winfree Fee	A-4	Mch., 1922	400	3,545	2	400	4,248	
Winfree Fee	A-5	4- 1-22	2,000	3,331	3	2,000	4,700	
Winfree Fee	A-6	9-18-22		3,800	2	400	4,009	SW.T.A.
Winfree Fee	A-7	7-21-23	2,000	3,573		2,000	3,573	P.L.O.
Winfree Fee	A-8	3- 1-24	500	3,391	1	800	3,564	32% B.S. & W.
Winfree Fee	A-9	6-14-24	1,900	3,611		1,900	3,611	3% B.S. & W.
Wm. Winfree Fee	B-1	12-24-21	2,500	3,400		2,500	3,400	
Wm. Winfree Fee	B-2	5-13-22	400	3,300		400	3,300	
Wm. Winfree Fee	B-3							
Wm. Winfree Fee	B-4							
Wm. Winfree Fee	B-5							
Wm. Winfree Fee	B-6			4,009			4,009	D. & A.
Hanford Oil Co.								
Bland	1	1903±		1,905			1,905	D. & A.
Harper Oil Co.								
Blanch	1	2-28-14		3,184			3,184	D. & A.
Higgins Oil & Fuel Co.								
Holland	1	7- 6-14		939			939	D. & A.
K. Kishi	1	5-14-14		3,358			3,358	D. & A.
Terry-Kishi	1	5-24-14		3,350			3,350	D. & A.
Hoffman & Turner Trsts.								
Foreman	1	June, 1916		3,760			3,760	D. & A.
Humble Oil and Refg. Co.								
Aaronson	1	3-25-22	No oil	3,662			3,662	30,000,000 cu. ft. gas.
Aaronson	2	10-28-22		4,625			4,625	D. & A.
Aaronson	3	11-10-22		626			626	D. & A.

WELLS IN ORANGE FIELD (*Continued*)

Operator and Lease	Well No.	Date Completed	I.P. Barrels	T.D. Feet 1st Comp.	Number W.O.	Highest I.P. Bbls.	Greatest T.D. Feet	Remarks
R. S. Barber	1	2- 5-26		5,000			5,000	D. & A.
Bland	1	May, 1920		3,465			3,465	D. & A.
Bland	2	5-12-23		3,690			3,690	D. & A.
Carbello	1	8-19-22	1,000	3,969	2	1,000	4,050	T.A.
Carbello	2	12-30-22		3,624			3,624	Dry, junked, & Abnd.
Chesson	1	Mch., 1920	50	1,760	1	1,500	3,900	
Chesson	2	12-18-20		2,050			2,050	D. & A.
Chesson	3	Not given			1		800	I.P. not given
Chesson	4	Sept., 1921		3,150			3,150	
Chesson	5	12-31-21	5,000	3,918		5,000	3,918	
Chesson	6	6- 3-22	100	2,925	1	100	4,000	
Chesson	7	4- 8-22		3,933			3,933	D. & A.
Chesson	8	Sept., 1922	150	4,100±	4	3,000	4,107	
Chesson	9	8-12-22	1,000	3,295	4	1,000	4,525	Junked & Abnd.
Chesson	10	Mch., 1922	2,500	4,300	4	2,500	4,740	40% B.S. & W.
Chesson	11	4- 8-22	3,000	3,930	3	3,000	3,944	
Chesson	12	6- 2-22		4,277			4,277	SW. Abnd.
Chesson	13	8- 5-22	4,500	3,462	1	4,500	4,282	
Chesson	14	6-17-22		4,270	1	2,500	4,753	I.P. small producer.
Chesson	15	8-27-23	75	3,088	1	750	3,178	
Chesson	16	6-30-22	125	3,411		125	4,375	Not worked over.
Chesson	17	4-23-23	125	2,727	1	200	3,093	
Chesson	18	2-20-24	No oil	4,233	3	2,500	4,233	
Chesson	19	6- 7-23	400	3,914	2	2,000	4,765	
Chesson	20	11-10-23	1,200	4,200	2	1,200	4,200	
Chesson	21	7-31-25	300	3,350		300	3,350	45% B.S. & W.
Chesson	22	8-28-25	375	3,168		375	3,168	40% B.S. & W.
Chesson	23	12- 4-25	3,400	2,660	2	3,400	4,892	
Chesson	24	1-15-26	1,200	4,670		1,200	4,670	
Chesson	25	7-16-26	1,500	3,500		1,500	5,192	D. & A.
Chesson	26	3-12-26		2,450			2,450	D. & A.
Chesson	27	10- 1-26	1,650	3,600		1,650	3,600	6% B.S. & W.
K. Kishi	1	Jan., 1922		4,329	2	750	4,329	I.P. small producer.
K. Kishi	2	3- 4-22	8,000	4,302		8,000	4,302	18% B.S. & W.
K. Kishi	3	7- 8-22	2,500	3,422		2,500	3,422	38% B.S. & W.
K. Kishi-Lang	1	12-18-20		4,334		1	4,334	D. & A.
Miller-Link	1	Sept., 1920		4,195			4,195	D. & A.
Myers Fee	1	4-22-22	150	3,180		150	3,180	
Myers Fee	2	6-21-22	150	3,120		150	3,120	
Myers Fee	3							
Myers Fee	4							
Myers Fee	5	5-21-26	10	3,300		10	4,955	
Myers Fee	6							
Paraffine	1	8-12-22	150	3,214	1	150	3,450	
Tasco	1	2-18-22	15	3,700	2	25	3,700	
Tasco	2	7-22-22	25	3,297		25	3,297	
Tasco	3	8- 1-23	75	3,418		75	3,418	
Winfree	1	7-13-21	700	3,100		700	3,100	
Winfree	2	4-22-22	150	3,500	3	2,000	3,582	
Winfree	3	6- 3-22	400	4,224		400	4,224	Flowing by heads
Winfree	4	12- 8-21	200	3,358	3	300	4,080	
Winfree	5	8-12-22	600	4,080		600	4,080	
Winfree	6	6-27-23	110	3,995	2	110	4,018	
Winfree	7	4- 7-23	100	2,892	2	2,500	3,900	
Winfree	8	7-15-22	125	3,310	1	125	4,910	D. & A.
Winfree	9	7-14-23	1,500	4,197		1,500	4,197	
Winfree	10	8- 1-24	180	2,860	1	300	3,600	
Winfree	11	2-13-25	1,000	4,665	2	1,000	4,670	
Winfree	12	9-25-25	1,600	4,620	1	1,600	4,620	D. & A.
K. Kishi Oil Co.								
Bland	1	1-27-23	1,500	3,100	1	1,500	3,100	
Bland	2							
Bland	3	5-19-23		3,370			3,370	D. & A.
Kishi	1	11-25-22	115	3,150		115	3,150	
Kishi	2							
Kishi	3	Not given		Not given	1		2,975	D. & A.
Kishi	4							
Kishi	5	Not given		Not given	1		3,130	D. & A.
W. P. McGuire	1							
W. P. McGuire	2							
W. P. McGuire	3							
W. P. McGuire	4							
W. P. McGuire	5	2- 6-25	No oil	3,200	2	500	3,375	
W. P. McGuire	6	10-23-25	550	3,565	1	550	3,565	80% B.S. & W. D. & A.
W. P. McGuire	7	Not given			1	1,850		I.P. not given.

WELLS IN ORANGE FIELD (*Continued*)

Operator and Lease	*Well No.*	*Date Completed*	*I.P. Barrels*	*T.D. Feet 1st Comp.*	*Number W.O.*	*Highest I.P. Bbls.*	*Greatest T.D. Feet*	*Remarks*
Smith-Foreman	1	7- 7-23	150	3,610		150	3,610	
Smith-Foreman	2	11-24-23	15	3,170	1	15	3,425	D. & A.
Lang Oil and Gas Co.								
Bland	2							
Link Oil Co.								
Hart-Adams	1	4-22-22		3,950			3,950	D. & A.
Little Six Oil Co.								
Mary Williams	1	6- 5-20		2,200			2,200	D. & A.
Lovejoy Knott								
Garrison	1	1911		1,100			1,100	D. & A.
Garrison	2	1912						D. & A.
H. T. McLean et al.								
Mary Williams	1	5-10-24		4,280			4,280	D. & A.
Monarch Oil and Refg. Co.								
Granger	1	2-18-22	500	3,180	1	1,000	3,290	D. & A.
Granger	2	5- 6-22	150	3,280	1	1,030	3,575	
Granger	3	5-27-22	200	3,585	1	200	3,585	
Granger	4							
Granger	5	6-10-22	250	3,260	2	300	3,416	
Harrison	1	5-20-22		3,225			3,225	Small producer
Mecom	1	4-21-22	No oil	3,355	3	15	3,425	D. & A.
Mexia Oil Co.								
Terrell	1	5- 6-22		95±			95±	D. & A.
Oilla Devl. Co.								
Wallace	1	6- 3-22		3,540			3,540	D. & A.
Orange Oil Co.								
LeFlore	1	July, 1920		3,600			3,600	D. & A.
LeFlore	2	8-14-20		765±			765±	D. & A.
Orange, Oil and Gas Co.								
Bland	1	May, 1916		1,820±			1,820±	D. & A.
Orange Petr. Co.								
Berwick	1	1- 2-22	200	3,351	2	2,000	3,650	
Berwick	2	4- 2-23	200	3,102	1	300	3,193	
Berwick	3	9- 7-23	No oil	3,485	5	700	4,304	
Chesson	1	1-18-21	50	2,014	2	1,512	3,709	
Chesson	2	7-16-21	No oil	3,214			3,214	D. & A.
Chesson	3	3- 4-22	800	3,600	5	1,000	4,304	15% B.S. & W.
Chesson	4	11-16-22	25	2,845	3	100	3,508	
Chesson	5	7- 5-23	125	2,987	1	300	3,300	
Chesson	6	9-11-25	1,500	4,633	1	1,500	4,633	40% B.S. & W.
Chesson	7	7- 2-24	75	3,570	1	75	3,570	D. & A.
Chesson	8	4- 3-25	200	3,570	3	200	3,725	D. & A.
Chesson	9	1-22-26	1,030	4,650		1,030	4,650	
Chesson	10							
Chesson	11	7-17-25	2,500	4,625	1	2,500	5,100	5% B.S. & W. D. & A.
Chesson	12	12-25-25	98	4,655	1	98	4,655	D. & A.
Chesson	13	12-12-30	160	3,160	1	160	3,182	25% B.S. & W.
Kishi	1	May, 1916		3,300			3,300	D. & A.
Lucas	1	1-21-22	250	3,360		250	3,360	
Mary Williams	A-1	6-18-26		4,800			4,800	D. & A.
Winfree	1	4-27-21	750	3,074		750	3,074	Formerly Toales Oil & Devl. Co.
Winfree	2	4- 3-22	1,750	3,694	1	1,750	3,694	
Winfree	3	11-20-21	250	3,343	2	250	3,550	20% B.S. & H_2O
Winfree	4	1-28-22	250	3,350	4	550	4,100	D. & A.
Winfree	5	4-29-22	300	3,375	2	1,800	4,765	50% B.S. & W. D. & A.
Winfree	6	6-10-22	2,500	3,280	1	2,500	3,280	
Winfree	7	9-16-22	135	3,375	1	135	3,580	
Winfree	8	3-26-23	750	3,342	4	750	3,600	
Winfree	9	8-11-23	400	3,550	3	400	3,550	6% B.S. & W.
Orange-Texas Oil Co.								
Duhing	1	July, 1920		3,000			3,000	D. & A.
Paraffine Oil Co.								
Garner	1	8-12-22	225	3,350	1	750	3,370	
Paraffine & Reliance Oil Co.								
Harmon	1	2-28-21		3,360			3,360	D. & A. West side field.
Pilot Oil Co								
Aaronson-Brancoff	1	5- 3-24		4,660			4,660	D. & A.
Producers Oil Co.								
Burton	1	Feb., 1914		3,510			3,510	D. & A.
Holland	1	Feb., 1914		3,615			3,615	D. & A.
Holland	2	Feb., 1914		2,700±			2,700±	D. & A.
Miller-Link	1	Aug., 1914		3,425			3,425	D. & A.
Pruitt-Mexia Oil Co.								
State-Land	1	Dec., 1921		2,810			2,810	D. & A.

WELLS IN ORANGE FIELD (*Continued*)

Operator and Lease	*Well No.*	*Date Completed*	*I.P. Barrels*	*T.D. Feet 1st Comp.*	*Number W.O.*	*Highest I.P. Bbls.*	*Greatest T.D. Feet*	*Remarks*
State-Land	2	5-13-22	400	3,830	1	800	3,830	
State-Land	3							
State Land	B-1							
Republic Prod. Co.								
Garner	1	9- 9-22		4,330			4,330	D. & A.
Rex Petroleum Co.								
Carbello	1	Oct., 1921	5,500	3,350	5	5,500	4,090	Formerly Edgerly Petr. Co.
Carbello	2	12-15-21	3,500	3,328	8	3,500	4,025	Formerly Edgerly Petr. Co.
Carbello	3	4- 1-22	200	3,398	4	300	4,787	Formerly Edgerly Petr. Co.
Carbello	4	4-29-22	3,500	3,667	2	3.500	3,667	65% B.S. & W. Formerly Edgerly Petr. Co.
Carbello	5	4- 8-22	1,500	3,150	3	1,500	3,350	Formerly Edgerly Petr. Co.
Carbello	6	3- 2-22	400	3,145	7	400	3,550	Formerly Edgerly Petr. Co.
Carbello	7	June, 1922	800	3,349	3	800	3,360	Formerly Edgerly Petr. Co.
Carbello	8	7- 8-22	300	3,260	2	300	3,301	Formerly Edgerly Petr. Co.
Carbello	9	7- 2-23	2,500	3,366	2	2,500	3,366	Formerly Edgerly Petr. Co.
Carbello	10	5- 7-23	2,500	3,359	6	2,500	3,560	Formerly Edgerly Petr. Co.
Carbello	11	9-12-25	No oil	3,308	3	75	3,440	Formerly Edgerly Petr. Co.
Carbello	12	3-24-23	150	3,150	1	150	3,165	Formerly Edgerly Petr. Co.
Carbello	13	4- 8-27	120	3,162		120	3,162	Formerly Edgerly Petr. Co.
Carbello	14	5-13-27	114	3,166	3	114	3,620	Formerly Edgerly Petr. Co.
Cornier	1	7-10-25	50	3,100		50	3,100	Formerly Edgerly Petr. Co.
Rio Bravo Oil Co.								
Blanche	1	4-12-14		4,010			4,010	D. & A.
Bland	1	8-17-13	150	3,227		150	3,227	Discovery well.
Mary Williams	1	4-21-14		3,209			3,209	D. & A.
Sandy Creek Oil Co.								
Stanton	1	May, 1922		3,300			3,300	D. & A.
Sinclair Oil and Refg. Co.								
Galliere	4	8-13-28	50	3,328		50	3,328	
Galliere	5	6-22-28	560	3,480	1	560	3,500	
Granger	1	1-27-22	500	3,176		500	3,176	
Granger	1-A	1-27-23	70	3,250		70	3,250	
Granger	2	7- 1-22	15	3,556	2	15	3,556	D. & A.
Granger	3	June, 1922		3,500±			3,500±	D. & A.
Granger	4	6-12-22	250	3,287	4	900	4,488	
Granger	5	4- 5-23	1,015	3,960	4	4,000	3,960	
Granger	6	9- 8-23	No oil	4,250	1		4,740	D. & A.
Hager	1							
Hager	2							
Hager	3	6-15-28	700	3,520		700	3,520	Orig. Atlantic Oil Producing Co.
Leon	2	Not given	Not given	Not given	1	75	2,750	Formerly Gulf Coast Oil Co. (?)
Leon	5	8-24-28	50	3,620	1	50	3,620	Orig. Gulf Coast Oil Co. 80% B.S. & W. D. & A.
State	A-1							
J. W. Turner	1	1-13-26		5,535			5,535	D. & A.
Stark-Brown Petr. Co.								
Kishi	1	12- 5-15		3,760			3,760	D. & A.
Stribling								
Garrison	1	1905±		1,500±			1,500±	D. & A. Also known as Brotcher well.
Sun Oil Co.								
Bellelle	1	4-22-22	400	3,200	5	400	3,661	
Bellelle	2	11 -4-22	170	Not given	1	170	4,270	
Bellelle	3	10-20-23	50	3.475	1	50	5,181	D. & A.
Brown	1	9- 4-22	125	4,201	1	125	4,201	
Brown	2	11-23-23	3,000	5,303	2	3,000	5,303	
Brown	3	3-24-24	4,000	4,617	1	4,000	4,617	18% B.S. & W.
Brown	4	6-14-24	No oil	4,665	1		4,665	D. & A.
Brown	5	Not given	Not given	Not given	1		5,200	D. & A.
Brown	6	1- 1-29		6,124			6,124	D. & A. SW.
Caron	1	3-12-26		4,900			4,900	D. & A.
Gunstream	1	7-15-22	35	3,350	1	2,000	4,080	
Gunstream	2	5-27-22	300	3,330	1	300	3,500	
Gunstream	3	12- 2-22	60	3,350	6	3,500	4,280	
Gunstream	4	8-18-23	1,600	3,425	4	1,600	3,965	
Gunstream	5	7-30-24	2,500	3,495	2	2,500	5,430	Dry, junked and abnd.
Gunstream	6	6- 5-25	265	4,890	1	265	4,890	
Gunstream	7	9-12-30	1,000	3,900	1	1,000	3,900	20% B.S. & W.
Johnson et al.	1	3- 5-26		5,704			5,704	D. & A.
Kato	1	5-17-23		3,208	4	10	5,000	I.P. Gas. D. & A.

WELLS IN ORANGE FIELD (*Continued*)

Operator and Lease	*Well No.*	*Date Completed*	*I.P. Barrels*	*T.D. Feet 1st Comp.*	*Number W.O.*	*Highest I.P. Bbls.*	*Greatest T.D. Feet*	*Remarks*
Kishi-Lang	1	11-25-22		4,485	1		4,503	D. & A.
Kishi-Lang	2	11- 2-23		1,539			1,539	D. & A.
Minor	1	7- 8-22	15	3,320	1	160	3,590	
Minor	2	6-10-22	90	3,150		90	3,150	
Michel	2							
Supreme Oil Co.								
Jackson	1	Not given	Not given	Not given	6	105	4,625	
Jackson	2	Not given	Not given	Not given	7	175	3,690	
Jackson	3	6-30-23	2,000	3,485	3	2,000	3,485	
Jackson	4	Not given	Not given	Not given	2	325	4,280	D. & A.
Terry Oil Co.								
Bland	1	Jan., 1913		2,000			2,000	D. & A.
Kishi	1	1913		1,250			1,250	D. & A.
Kishi	2	Mch., 1914		3,128			3,128	Dry. Taken over and deepened by Stark & Brown as the Orange Petr. Co.
Pevito	1	July, 1914		2,670			2,670	Blow-out at 1,250–90 ft.
Thrift Oil Co.								
McGuire	1	1-20-22		3,537			3,537	
McGuire	2	5- 6-22	600	3,222	1	600	3,550	
McGuire	3	9- 9-22		2,775			2,775	D. & A.
Tillery Oil Co.								
State	1	7-21-23	215	3,510	3	1,600	3,940	
State	2	Not given	Not given	Not given	5	500	4,050	
State	3	9- 9-27	1,300	3,400	3	1,300	3,950	60% B.S. & W.
State	B-3	1-23-29	630	3,512		630	3,512	
State	4	9-27-28						Location Abnd.
Tasco	2	Not given	Not given	Not given	1	25	3,300	
Tasco	3	8- 1-23	75	3,418	3	250	3,900	Formerly Humble O. & R. Co. D. & A.

CONCLUSIONS

1. Orange dome is a deep salt dome whose major axis extends north and south.

2. The Miocene beds are block-faulted in the same manner as in the deep domes at Iowa and Manvel, the central graben yielding the Miocene production.

3. The presence of heaving shale in the Gulf Production Company's Pevito No. 11 and adjacent wells, indicates an unconformity in the central part of the dome with the *Marginulina*-Frio section missing on top, *Heterostegina* overlapping onto Vicksburg in the central part of the dome. It is inferred that around the periphery—exact location at present unknown—this missing *Marginulina*-Frio wedge makes its appearance.

BULLETIN OF THE AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS
VOL. 20, NO. 5 (MAY, 1936), PP. 560-611, 27 FIGS.

GEOLOGY AND GEOPHYSICS SHOWING CAP ROCK AND SALT OVERHANG OF HIGH ISLAND DOME, GALVESTON COUNTY, TEXAS[1]

MICHEL T. HALBOUTY[2]
Houston, Texas

ABSTRACT

The High Island dome was first drilled for oil in 1901; however, the first production was obtained from the porous cap rock in 1922, on the super-dome structure. The Yount-Lee Oil Company in 1931 proved the existence of an overhang at High Island and has since developed the field from the northwest flank to the southeast flank. The development at present is toward the east flank.

The cap rock at High Island is divided into a false cap rock and a true cap rock. The false cap rock is a hard sand and lime rock ranging in thickness from 200 to 1,300 feet. The true cap rock lies underneath the false cap rock and consists of a series of caps. At the base of the series is anhydrite which grades upward into gypsum and a calcite cap above the gypsum.

The overhang has so far been proved to exist on all flanks that have been drilled. There is a cap-rock overhang as well as a salt overhang; the cap-rock overhang extends outward and away from the salt. Production is just as prolific under the cap-rock overhang as under the salt overhang. The dome is somewhat lopsided in that the southeast flank is approximately 1,500 feet higher than the northwest flank. Faulting has been detected on the south and southeast flanks. A theoretical peripheral fault is mapped from the northwest to the southwest flank. Oil has been produced in commercial quantities from the cap rock, Pliocene formation, Miocene formation, *MDv* zone, *Discorbis* zone, and *Marginulina* zone. The *Heterostegina* zone at High Island has not yet been penetrated or encountered. The Pliocene and Miocene production is very small and practically all of the sands in these two formations contain water.

The *MDv* zone is a new paleontological zone mapped by the writer as lying immediately above the true *Discorbis* zone of the Middle Oligocene, and equivalent to Lower Miocene in age. This new zone is characterized by both Lower Miocene and true *Discorbis* fauna. Therefore, the name *MDv* has been chosen to represent the zone because of the occurrence of Miocene fauna associated with *Discorbis* cf. *D. vilardeboana* and its fauna; thus, the name: *MDv*.

The *MDv* zone has so far been proved to be the most prolific of any productive zone. Six different sand horizons have been found in this zone. The *Discorbis* zone production has been limited; however, some of the company's latest and best wells are producing from this zone. Only one sand has been found in the *Marginulina* formation. The oil at High Island is divided into three types, ranging from 24° to 44° A.P.I. gravity.

LOCATION

The High Island salt dome is located approximately halfway between Sabine Pass and Galveston, about one mile from the edge of the

[1] Presented before the Houston Geological Society, Houston, Texas, November, 1935. Read in part before the Association at the Tulsa meeting, March 20, 1936. Presented and published by permission of the Yount-Lee Oil Company, Beaumont, Texas. Courtesy permission obtained from Stanolind Oil and Gas Company.

[2] Former chief geologist and petroleum engineer, Yount-Lee Oil Company, Beaumont, Texas. Present position: chief geologist and petroleum engineer, Glenn H. McCarthy, Inc., Interests, Sterling Building, Houston, Texas.

Gulf of Mexico in Galveston County. The Gulf, Colorado, and Santa Fe Railroad, operating from Beaumont to Galveston, crosses the northwest edge of the hill where the townsite of High Island is located. The dome can be reached by State Highway No. 125, southwest from Beaumont via Fannett and Winnie to Stowell, and thence by State Highway No. 124 to High Island, a distance of 45 miles, or by State Highway No. 87, west from Port Arthur via Sabine Pass, a distance of 38 miles, or by the same highway, northeast from Galveston, crossing Galveston Bay by ferry to Bolivar Point, thence via Patton, Caplen, and Gilchrist, a distance of 36 miles. The dome can also be reached by small motor boat from Galveston via the Gulf of Mexico, and by boat via the Intracoastal Canal, which is located ½ mile west of the dome, and also 2 miles north of the dome, where State Highway No. 124 crosses the canal.

HISTORY

The High Island salt dome was first described by Fenneman[3] in 1906, later by Halbouty[4] in 1932, and was referred to in a general paper by Judson and Stamey[5] in 1933. Surface indications, which consist of a hill similar to the mound at Spindletop and an abundance of inflammable sulphurous gases, led to the belief that the area might produce oil. The first prospective oil well at High Island was drilled in 1901 by Chase and Newsome, et al., independent operators from Galveston, Texas. At an approximate depth of 900 feet, this well was abandoned in cap rock with no oil showings reported. Later, in 1902, the old J. M. Guffey Petroleum Company drilled three wells, two on the Cade tract, and one on the Guidry tract, on the top of the dome. One of the Cade wells was drilled to a total depth of 2,600 feet, and the last 1,300 feet was drilled into salt. This salt penetration remained a record in the Gulf Coast for a number of years. The other two wells were abandoned in cap rock. The J. M. Guffey Petroleum Company, because of difficulty in securing a mutually satisfactory agreement with the lessors, finally abandoned operations in 1903. That same year Monroe Carroll of Beaumont drilled one well, Smith No. 1, to a total depth of 1,250 feet, with a showing of oil reported in porous rock at 1,100 feet. This well was finally abandoned in 1904.

[3] N. M. Fenneman, "Oil Fields of the Texas-Louisiana Gulf Coastal Plain," *U. S. Geol. Survey Bull. 282* (1906), pp. 79–83.

[4] M. T. Halbouty, "High Island Dome, Galveston County, Texas," *Bull. Amer. Assoc. Petrol. Geol.*, Vol. 16, No. 7 (July, 1932), pp. 701–02.

[5] Sidney A. Judson and R. A. Stamey, "Overhanging Salt on Domes of Texas and Louisiana," *Bull. Amer. Assoc. Petrol. Geol.*, Vol. 17, No. 12 (December, 1933), pp. 1511–13.

Thereafter activity ceased for several years at High Island. In 1912 and 1913 the Gulf Production Company drilled two wells, one on the west side and the other on the northwest side of the dome. Both of these wells had oil showings, but evidently did not warrant testing or further drilling, as the wells were abandoned, and the company moved out. In 1914, W. C. Patton and W. Robichaux leased a number of acres in the Smith, Cade, and Guidry tracts. The first well of the small company was drilled in 1915 on the Biglin Survey in Block No. 11, on the east flank of the dome. The destructive 1915 storm blew the derrick down and stuck the drill stem at 2,250 feet, the total depth of the well, which caused its abandonment. Another well by this company was drilled on the Cade lease, but was abandoned in December, 1915, at a depth of 1,235 feet. In 1916, Marrs McLean of Beaumont took over the leases that Patton et al. held and drilled three wells, which were all abandoned in cap rock. McLean released most of his holdings to the Sun Company and that company began operations in earnest in March, 1919, in the hope of obtaining production at High Island. Three wells were drilled on the Cade lease, but were abandoned with no production.

In 1922, W. C. Patton organized the Patton Oil Company, and obtained leases from the Cade Estate and W. D. Gordon, on top of the dome, drilled the Patton Oil Company's Cade No. 1 to a total depth of 155 feet in porous cap rock saturated with oil, and brought this well in as a commercial producer with an initial flow of 20 barrels per day. This well was brought in on the 12th day of April, 1922, and marked the inauguration of commercial production of oil at High Island, and, in fact, the first commercial production in Galveston County. Patton immediately followed up with fifteen wells drilled on top of the dome, four of which became producers from the porous cap rock. The best one of these wells produced 500 barrels of oil per day at a depth of 198 feet. A few years later the Yount-Lee Oil Company purchased controlling interest in the Patton Oil Company.

The Sun Company, having been idle at High Island since 1920, began new operations and drilled their Cade well No. 4 to a depth of 2,219 feet for a 5-barrel producer on the beam. The well finally sanded up and was abandoned. The second producer for the Sun Company was their Broussard and Orme No. 1, which was completed in June, 1923, with an initial flow of 638 barrels, but which sanded up and ceased flowing. Sun's Cade No. 6 and Cade No. 10 also became small producers, but the wells were later abandoned. The Sun Company extended their operations on all flanks of the dome. The Sun Company drilled twelve wells on the Lockhart tracts, eleven wells on the Cade

tract, eight wells on the Cade "C" tract, two wells on the Broussard and Orme tract, and one well on the Guidry tract, making a grand total of thirty-five wells drilled from 1919 to 1927. Of these, six made weak producers which were finally abandoned. In 1927 the Sun Company turned some of their leases back to Marrs McLean, retaining some, and releasing the remainder to the land owners, and ceased their operations at High Island.

During the Sun Company's major activity in those years, the Yount-Lee Oil Company drilled four wells on the Albert Guidry tract, three of which were abandoned in cap rock and one in salt, and drilled two wells on the Smith tract. Of these No. 1 was abandoned at 1,682 feet, and No. 2 at 4,124 feet. These six wells were drilled in 1923.

In 1927, Marrs McLean began drilling new wells on the Cade lease on the northwest and southwest sections of the dome, and worked over the old Sun Company's Cade "C" well No. 6 on the southeast flank. This proved to be a good producer for McLean. The northwest section proved to be the most productive. A total of nine wells were drilled with all showing oil and six making some production.

The Gulf Production Company came back in January, 1926, and drilled on their Smith "A" lease. This company operated on the Smith "A", Smith, Nellie B. League, and Spencer tracts, drilling five wells on the "A" lease, ten wells on the Smith, one on the Nellie B. League, and one on the Spencer, before selling their leases and fee lands to Marrs McLean in 1930. In turn Marrs McLean and the Sun Oil Company transferred all their leases and fee lands over to the Yount-Lee Oil Company in 1930, with the exception of a few leases retained by the Sun Oil Company as hereinbefore mentioned. By acquiring other leases and fee lands, the Yount-Lee Oil Company, by the beginning of 1931, owned in fee or had leased practically the entire possible producing acreage at High Island, some of their holdings extending into the Gulf of Mexico.

On April 20, 1931, the Yount-Lee Oil Company commenced drilling Cade well No. 21, their first location made after their first unsuccessful venture in 1923. On July 30, 1931, Cade No. 21 was completed, yielding 700 barrels initial production per day on $\frac{1}{4}$-inch choke, 33° gravity A.P.I. oil. This marked the first deep production at High Island and the inauguration of a drilling campaign that is now one of the foremost in the Gulf Coast and makes this dome one of the most prolific productive salt domes in the entire coastal area.

Cade No. 21 proved the presence of an overhang of cap rock and salt; the existence of deep production, never before found; and the fact that producing sands lie under the overhang. One-half of the

dome, from the northwest and west to the southeast, has been proved productive, and progress is now being made in drilling the east flank. Sixty wells have been drilled by the Yount-Lee Oil Company since 1931, of which forty-six proved productive. Eight wells have been worked over and seven of these are producing from a lower sand than set in originally. Since April 1, 1935, the production allowable as set by the Texas Railroad Commission has been 6,614 barrels per day for the entire field.

Some idea of the development of the field can be gained from Table I, which shows the annual production since the completion of the first producer on top of the dome by W. C. Patton in 1922.

TABLE I

Year	*Barrels*
1922	2,700
1923	12,500
1924	19,141
1925	124,200
1926	58,420
1927	93,500
1928	170,450
1929	447,378
1930	341,376
1931	272,700
1932	1,507,926
1933	2,468,000
1934	2,773,400
From Jan. 1 to April 1, 1935	1,054,426
Total	9,346,117

Prior to the later major activities of the Yount-Lee Oil Company, it was extremely difficult to obtain fresh water with which to carry on drilling operations successfully without interruptions, and many shallow wells were drilled in search of fresh water, with little success. As these water wells were completed, a supply would be reserved for use in later drilling, but the supply was insufficient, necessitating numerous shut-downs in drilling. When the Yount-Lee Oil Company brought in their first producer, and the extent of future drilling became apparent, this company, in the fall of 1931, built a 6-inch pipeline from a point approximately 9 miles northeast of High Island at Elm Bayou to the northeast flank of the dome. At the Elm Bayou end of this line the company built a large reservoir to impound fresh water accumulated from rains falling on the area, or, in the absence of rains, to hold fresh water pumped from the Trinity River through a series of cross-country canals and laterals leading into the reservoir. In this manner, ample fresh water is at all times assured the field, as electrically operated pumps are situated on the reservoir banks which are

used to pump water through the water pipe-line into the field reservoir at High Island.

Prior to the entrance of the Yount-Lee Oil Company at High Island in 1931, the oil produced at High Island and marketed was transported by tank cars over the Gulf, Colorado, and Santa Fe Railroad. As soon as it was evident that commercial production would be obtained in large quantities, the Yount-Lee Oil Company, in the fall of 1931, built a 10-inch pipe-line from High Island to the Yount-Lee Spindletop tank farm. The greater part of the right-of-way for this line is on the Gulf, Colorado and Santa Fe Railroad right-of-way.

For water transportation of oil, if necessary, the Intracoastal Canal, 9 feet deep and 100 feet wide at the bottom and 110 feet wide at the top, which has been completed from New Orleans to Galveston, affords transportation of oil to various dock terminals at a minimum cost.

An electric transmission line, built from Beaumont to High Island in 1932 by the Gulf States Utilities Company, furnishes electric power to the field and town.

Other companies now holding acreage at High Island are The Texas Company, the Atlantic Oil Refining Company, the Sun Oil Company, The Republic Production Company, and the Continental Oil Company. In most instances, the acreage held by these companies is relatively small.

ACKNOWLEDGMENTS

The author wishes to express his appreciation to E. U. Henry, chief engineer of the Yount-Lee Oil Company, for his many suggestions and criticisms, and for his kind permission to present this paper for publication. Appreciation and thanks are also extended to F. W. Mueller,[6] assistant geologist for the Yount-Lee Oil Company, for his valuable assistance in the compiling of the geological data and for his many geological observations that were ultimately embodied in this report. Thanks are also extended to the Stanolind Oil and Gas Company for their courtesy and permission to publish this paper, as it was not completed until after the sale of the Yount-Lee Oil Company to that concern.

The author also extends his appreciation to W. C. Patton, pioneer oil operator at High Island, and to H. E. Viterbo of Beaumont, Texas, for many interesting historical data connected with the development of the dome.

[6] F. W. Mueller is at present assistant geologist for the Skelly Oil Company, Houston, Texas.

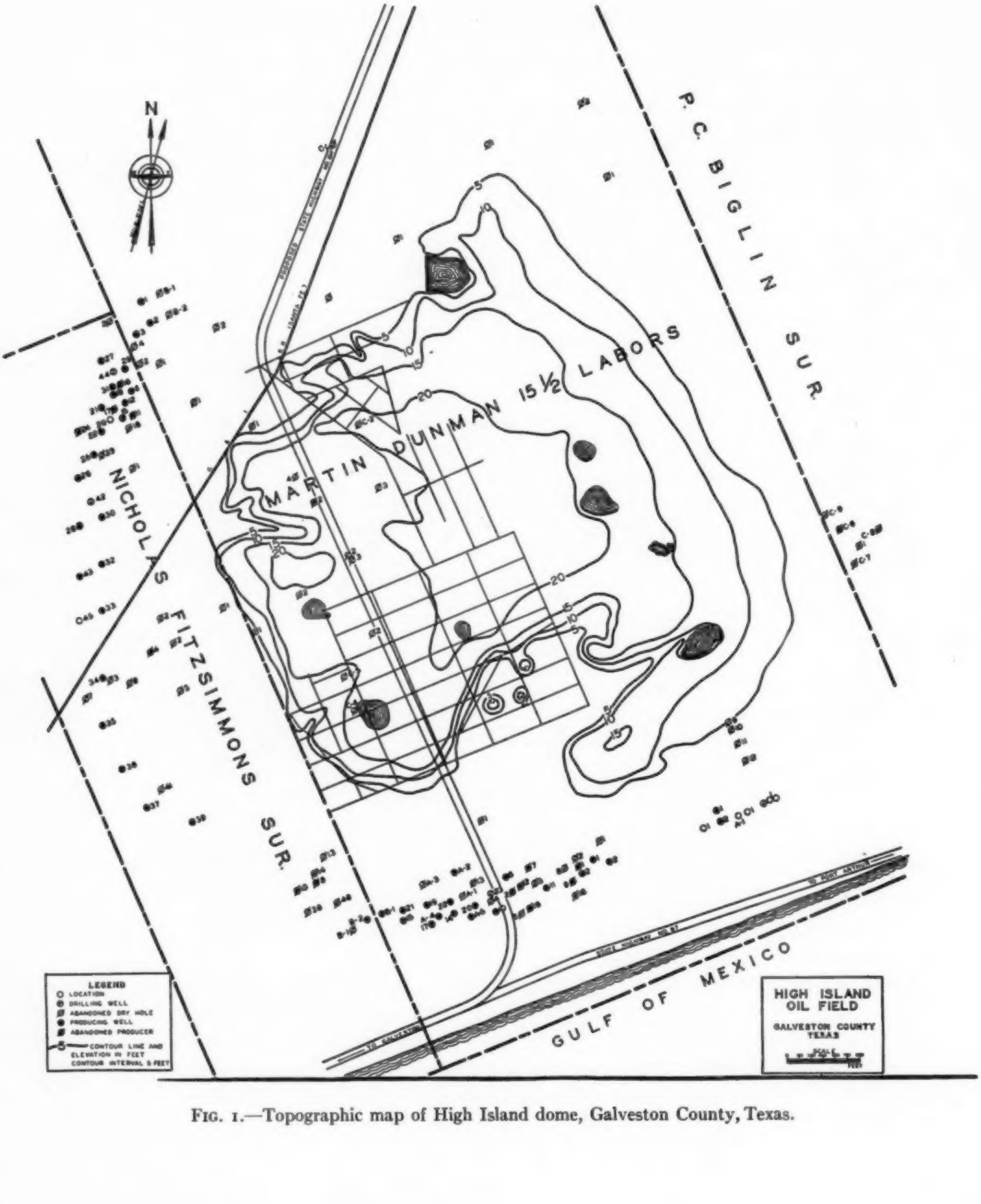


FIG. 1.—Topographic map of High Island dome, Galveston County, Texas.

PHYSIOGRAPHY

The topography of the High Island dome is that of a mound rising out of the coastal marshes to a height of approximately 20 feet. The mound is irregular in shape with a general radial drainage to the surrounding flat marshes. The slopes on the south, west, and north flanks are steeper and more abrupt than the slope on the east. The western edge of the mound is characterized by numerous gulleys caused by erosion.

Numerous sink-holes, filled with fresh water, exist on the top of the hill. The mound proper is covered by very fertile soil.

On the south side of the mound, is a low marshy area which extends northeastward from the south marsh, forming a hollow bowl-like feature nearly surrounded by the outer edges of the mound. Rising from the floor of this hollow are two small circular mounds about 10 feet high and from 100 to 150 feet in diameter, which are completely surrounded by the marsh lands. Around the edges of this bowl-like feature are three topographic dome-shaped noses extending outward into the marsh. On the north flank is a similar but smaller hollow bowl-like feature with its attendant topographic noses, which has been dammed and is now used as a water reservoir (Fig. 1).

The east flank of the mound is more regular, with no outstanding rugged erosional feature and with a gentle slope toward the east marsh from the top of the mound.

On the northwest, west, and south flanks, immediately adjacent to the mound proper, is a trough-like depression in the marsh which is lower than the surrounding marsh away from the dome, and in which water is always present except in extraordinarily dry seasons. This trough does not exist on the east flank of the mound, as the marshlands adjacent to this flank are above the average elevation.

The marsh surrounding the dome is typical of Gulf Coast marshes, with an approximate mean elevation from sea-level to one foot. One-half mile south of the south flank of the dome is a beach ridge approximately 700 feet in width, which extends along the edge of the Gulf of Mexico.

The general slope of the marsh, which normally is very slight, is toward the East Bay Bayou and its tributaries on the north and northwest.

SURFACE GEOLOGY

The Beaumont clays of Pleistocene age are exposed at the surface at High Island. The clays on the hill are buff to grayish red, and are used extensively by the state for road-building purposes. In the

marsh, the clays are dark gray to black and are greatly affected by the salt water which enters the marsh at high tides, subsequently causing the clays to be highly brackish and very soft and mucky. The clays on the hill are not brackish and are well compacted and firm. Erosion has formed numerous gulleys on the west, north, and south flanks of the mound, and the alluvial sediments thus eroded are deposited in the surrounding flats.

STRATIGRAPHY

The Beaumont clays at High Island range in thickness from 50 to 250 feet. On the surface of the dome proper the clays are compact; on the outer flanks the surface clays are soft and loamy. Below the surface, the clay becomes exceedingly compact and sticky and is considered as a very fine mud-making clay.

The Lissie formation of Pleistocene age underlies the Beaumont clays and its appearance is definitely marked by the first sand break encountered below the Beaumont clays. The Lissie formation is characterized by sands, sands and gravels, a few small layers of shale and sandy shales, and large bodies of sands and boulders intermingled with sandy shales. Numerous water sands are encountered in this formation. On the super-dome structure the Lissie formation is from 25 to 100 feet thick, as the cap rock is penetrated at a very shallow depth. Off the super-dome structure the formation increases in thickness considerably, the minimum thickness being 1,600 feet and the maximum thickness 2,000 feet.

The Upper Pliocene formation, which is referred to as the Citronelle, makes its appearance with limestone and nodular calcareous shale bodies. Shales and sandy shales are dominant in this formation. The thickness ranges from 600 to 800 feet.

The Lower Pliocene formation, or Upper Fleming, is identified by sandstone, limestone, sandy shales, and shales. This formation is from 1,200 to 1,400 feet in thickness.

The Upper Miocene formation, or Lower Fleming, is composed of gray calcareous sandstones, limestones, and green compact shales, intermingled with bodies of fine- to medium-grained sands. The top of the Miocene formation is consistently marked around the field by the *Potamides matsoni*[7] zone placed in the section at the extreme top of the Upper Miocene. The formation ranges in thickness from 500 to 800 feet.

Underlying the Upper Miocene formation at High Island are a series of sands and sandy shales called by the author the *MDv* (Mio-

[7] Alva C. Ellisor, "The Potamides Matsoni Zone of Texas," *Bull. Amer. Assoc. Petrol. Geol.*, Vol. 20, pp. 494–95.

cene-*Discorbis vilardeboana*) zone. These strata are so named because of the appearance and interassociation of *Discorbis* cf. *D. vilardeboana* D'Orbigny and associated fauna with *Rotalia beccarii* (Linne) D'Orbigny and associated fauna. This zone is definitely outlined for a thickness of 250–800 feet, easily correlated in the field. In this zone is found one of the most prolific oil sands at High Island. Thirty-six of the forty-six initial productive wells brought in by the Yount-Lee Oil Company since 1931 are producing from this zone. Such a zone, which the author has found to occur only down-dip near the coast line, and to be prominently outstanding in the section, can be explained by the regression of the *Discorbis* sea and transgression of the Miocene sea which ultimately describes the zone from a geological viewpoint as one of transition. During the latter stages of the regression of the *Discorbis* sea environmental conditions were so changed that they caused the *Rotalia beccarii* (Linne) D'Orbigny and its associated fauna to evolve; however, these environmental changes were not unfavorable enough to cause the extinction of the *Discorbis* fauna. Therefore, when transgression of the Miocene sea began, environmental conditions were still favorable for the continued existence of the *Discorbis* fauna, but as the sea continued to transgress, the environmental conditions gradually changed which subsequently caused the *Discorbis* fauna gradually to become extinct.

As the *Discorbis* sea was receding and the Miocene sea was transgressing, terrestrial deposits of the so-called Catahoula age were being laid down, equivalent in age to part or the whole of the marine *MDv* zone. An important criterion to note is that the *Discorbis* cf. *D. vilardeboana* D'Orbigny vary in size from normal to large, then to dwarf size, from the bottom to the top of the *MDv* zone. This change in sizes may be attributed to a series of environmental changes which affected the growth of the organism. Such changes in sizes were not noted in the *Discorbis* associated fauna. The *Rotalia beccarii* (Linne) D'Orbigny appear very small at the base of the zone, but increase to normal size and remain such throughout the period of transition.

There is no definite lithological break either at the top or bottom of this *MDv* zone as the zonal markings are based entirely on paleontological determinations. The first appearance of the *Discorbis* fauna as associated with the Miocene fauna defines the top of the zone, and the complete disappearance of the *Rotalia beccarii* (Linne) D'Orbigny marks the top of the *Discorbis* zone as Middle Oligocene. Therefore, this zone occurring down-dip is thereby called the *MDv* zone because it marks a period of transition between the *Discorbis Zone* (Middle Oligocene), and the Miocene formation; the zone being in part equiv-

alent to both the Catahoula and the Lower Miocene formations, characterized by the interassociation of Miocene fauna and *Discorbis* cf. *D. vilardeboana* and its associated fauna; therefore, *MDv* being symbolic for Miocene formation and *Discorbis* zone characteristics, paleontologically.

The *MDv* zone is characterized by numerous sand and sandy shale bodies with dark green shale and limestone occurring in relatively thin layers. The lower shales are bentonitic and dark to light greenish gray in color. The thickness of the zone varies from 250 feet, where pinching-out has been the greatest, to 800 feet off the flanks of the dome.

The *Discorbis* zone is identified by the disappearance of the *Rotalia beccarii Foraminifera* associated with a change in lithology. The lithological change is not very prominent; however, it can be noticed as the Miocene fauna disappears. The *Discorbis* contact is one usually determined by paleontology. The zone is irregular in thickness, and ranges from about 150 to 500 feet thick as determined by dips of cores and depth penetrated. In one well alone, over 1,100 feet of *Discorbis* zone formation was drilled; however, the dips of the cores taken in the formation indicated that the formation normally would be approximately only 450 feet thick. This zone is characterized chiefly by a light greenish gray, slightly calcareous to calcareous, bentonitic, brittle shale lying at the base of the *MDv* zone, which has a high absorptive power which makes it likely to heave in the hole. This heaving condition is characteristic of all the shale bodies in the zone, and at one time was very troublesome in drilling. However, since 1933 this shale has been found to be easily penetrated at High Island by the use of chemicals and treatments of the drilling fluid; thus *Discorbis* production is now obtained as easily as Miocene production. Previous to the mud treatments at High Island, this shale was impenetrable, and several wells were abandoned, or it was necessary to set casing above the shale in Miocene sands and *MDv* zone sands. The zone is also characterized by small productive sand bodies and layers of (indurated) sandstone lying above the sands as sandcaps.

The *Heterostegina* zone strata, to date, have not been penetrated at High Island.

The *Marginulina* zone has been penetrated 106 feet by one well, the Yount-Lee Oil Company's Smith No. 17. The zone consisted of light bluish gray, calcareous, massive shales, sandy shales, and limy shales with an abundance of *Marginulina* zone *Foraminifera* definitely marked by *Marginulina* cf. *M. philippinensis*.

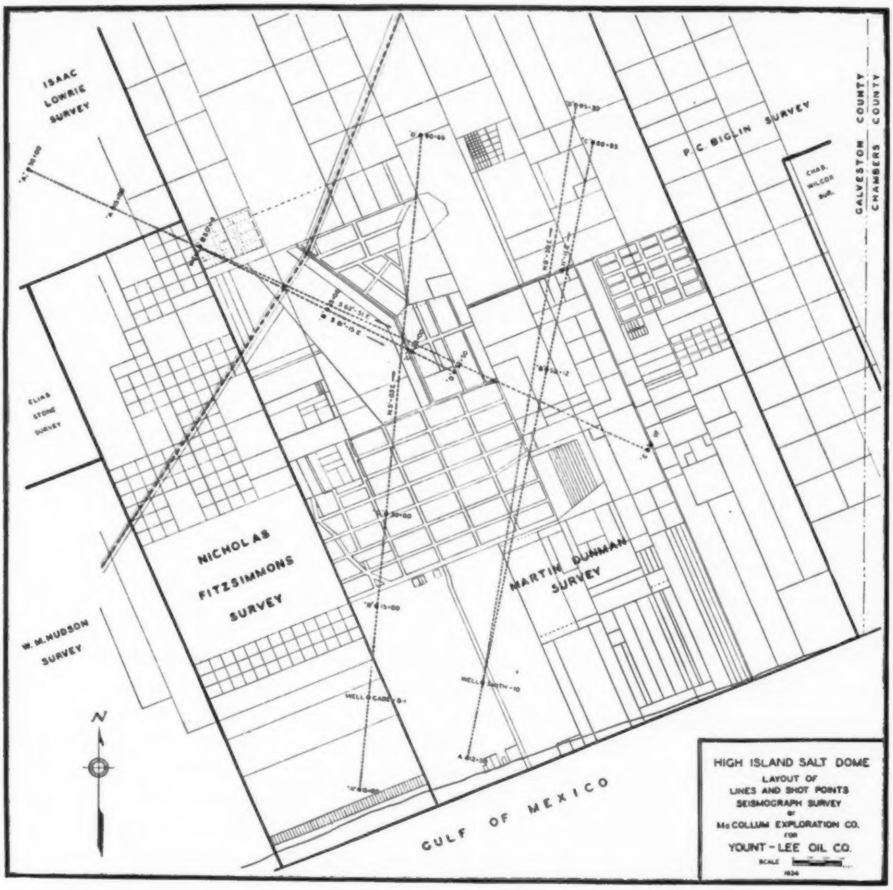


FIG. 2.—Layout of shot-point lines for seismograph survey.

No Frio formation has been encountered at High Island.

The Vicksburg formation occurs at High Island immediately underneath the salt overhang; it has not been found otherwise (Figs. 15, 18, 19, 20, and 23). This formation consists of light greenish gray to dark green, calcareous, bentonitic shales, which are extremely conducive to heaving and caving in the hole if not properly treated with chemical muds, and which contain an abundance of Middle Vicksburg *Foraminifera*, that is, an abundance of calcareous specimens relatively characteristic of the *Bulimina* zone. The maximum thickness of this formation as found in the Yount-Lee Oil Company's B. & O. "B" No. 2 is 391 feet. In this well the *Discorbis* zone was underlying the Vicksburg (Fig. 23).

In the Yount-Lee Oil Company's Cade "B" No. 2, salt was encountered from 4,470 feet to 4,866 feet. However, at 4,837 feet a core was taken that contained 2 feet of dirty salt; 6 inches of chocolate-brown, calcareous, fossiliferous shale with an abundance of *Foraminifera* which were definitely identified as of Whitsett (Upper Jackson) age and marked by *Bolivina jacksonensis* Cushman and Applin and *Bulimina jacksonensis* Cushman; and 3 feet of clear salt underneath the shaly salt, which completed the core. Evidently the Whitsett shale was an inclusion in the salt carried up with the upthrust of the dome, as below the point of this inclusion 27 feet of salt were present. Immediately below the salt, the Miocene formation was encountered.

GEOPHYSICS

A seismograph survey of the flanks of the High Island dome was made in October, 1934, by the McCollum Exploration Company[8] of Houston, Texas. The survey was conducted for the purpose of determining the amount of "mushrooming" or overhang existing on the northwest flank and the south flank of the dome by means of profiles calculated from the seismograph results.

In a survey, a modification of the standard refraction method was employed, wherein a detector or recording device is lowered into wells near the flank of the dome. With the detector occupying, successively, positions spaced at intervals of 125 or 250 feet from top to bottom of the well, a series of time values was recorded from shot points both "on" and "off" the dome. These time values, when taken with their corresponding distances between shots and detector, give sufficient data to calculate the point at which the seismic wave emerged from

[8] Geophysical data taken from a thesis titled "Report on Refraction Survey of High Island Dome for the Yount-Lee Oil Company" by the McCollum Exploration Company. Reported November 1, 1934.

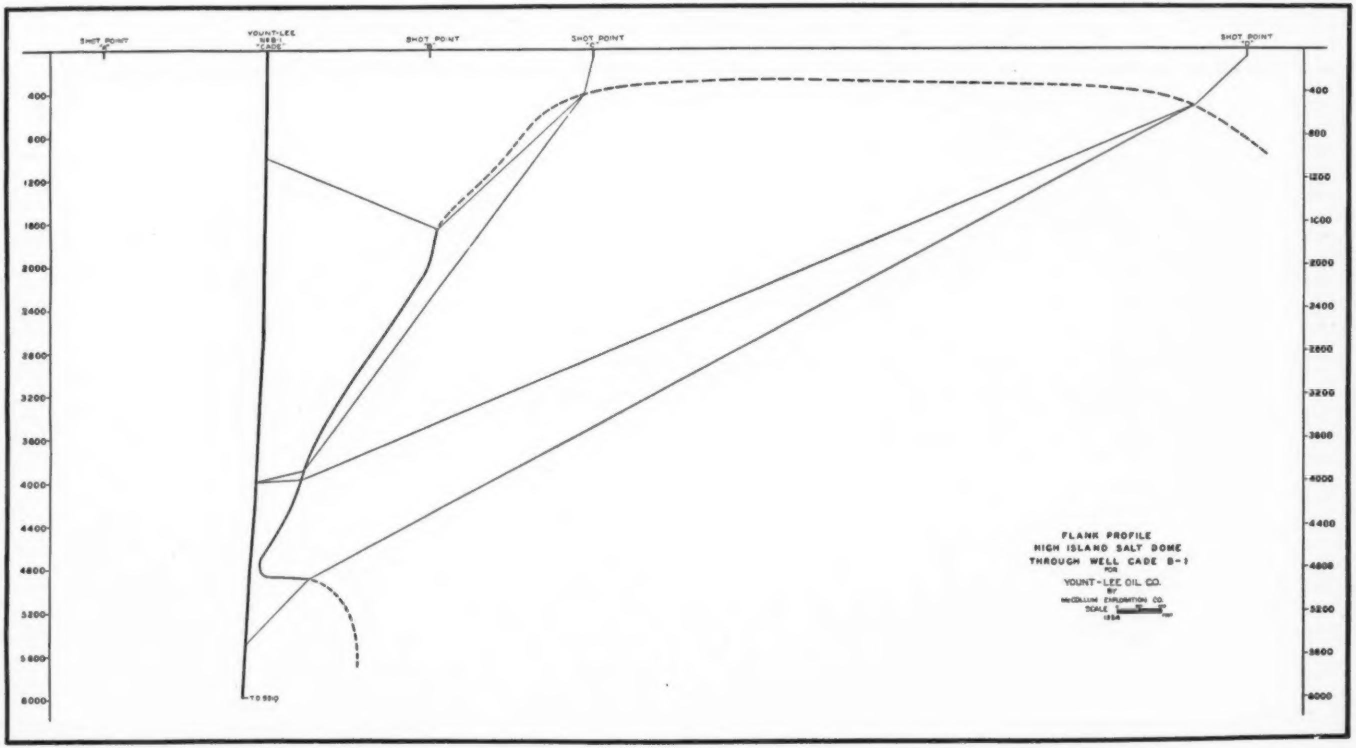


FIG. 3.—Seismograph flank profile of High Island salt dome from southwest flank (left) to northeast (right).

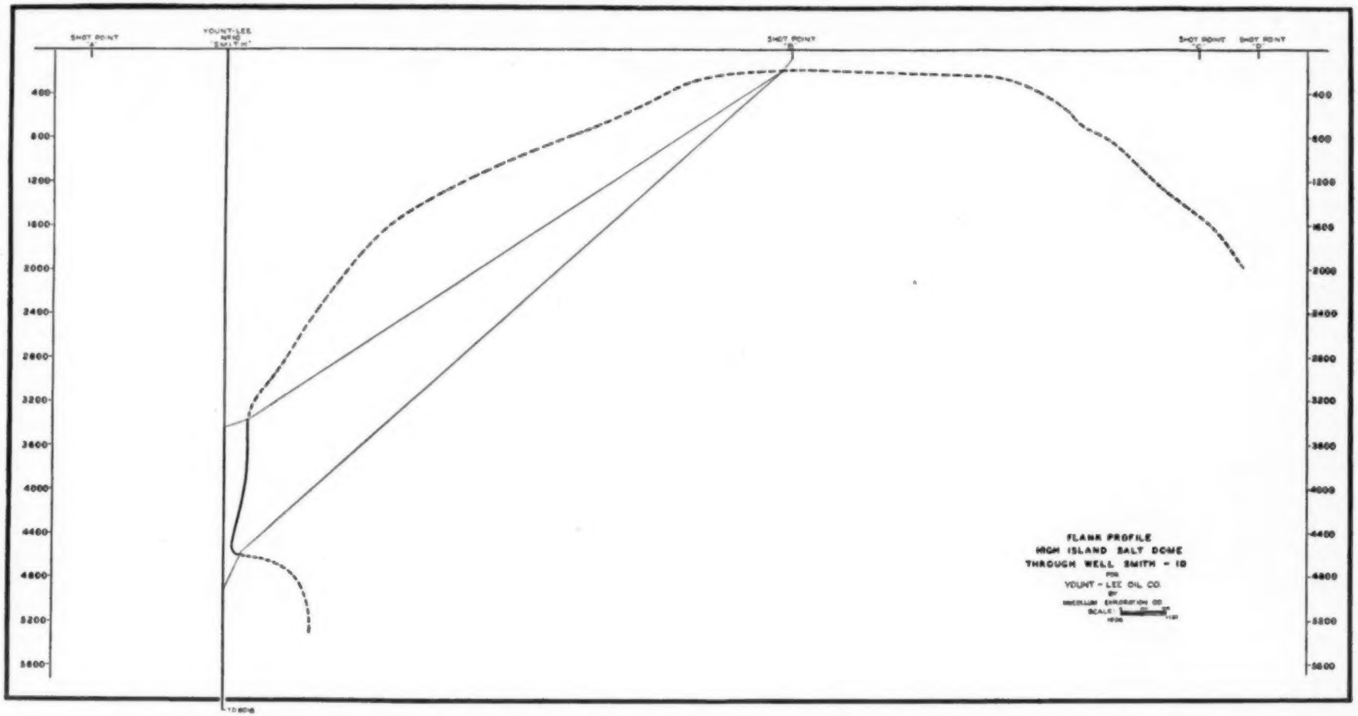


FIG. 4.—Seismograph flank profile of High Island dome from the south flank (left) to northeast (right).

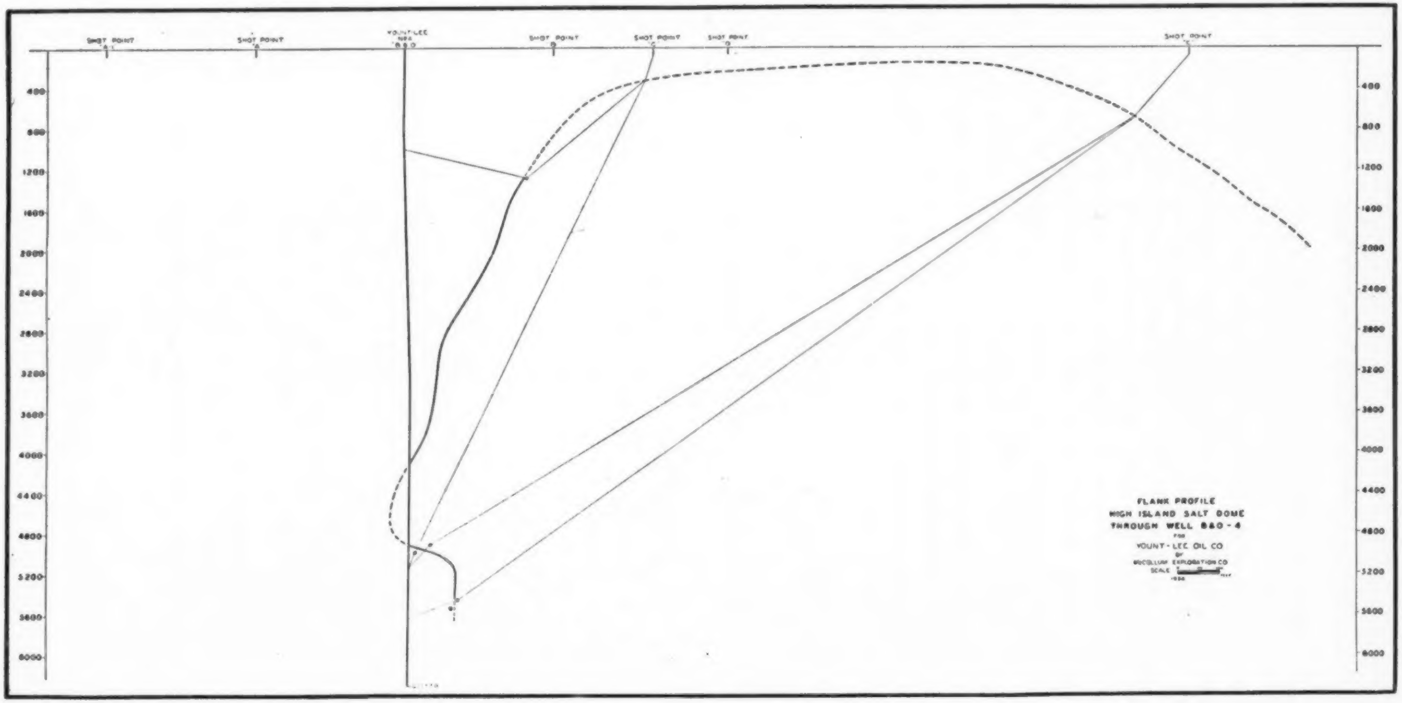


FIG. 5.—Seismograph flank profile of High Island dome from northwest flank (left) to southeast (right).

the dome in each instance. This method of profiling has added advantages over the standard method in that the profile is not limited to the knee of the dome, but can be carried approximately to the depth of the detector unless the amount of overhang is in excess of the depth of a well that may be available below the point where "mushrooming" begins, and in that case only the minimum amount of "mushrooming" or overhang can be ascertained.

The survey was made from three wells, namely, the Yount-Lee Oil Company's B. & O. No. 4, and Cade "B" No. 1, and the old Gulf Production Company's Smith No. 10. The B. & O. well is located on the northwest flank of the dome, the Cade well on the southwest flank, and the Smith well on the south flank. Figure 2 shows the layout of the lines and shot-points leading from these three wells. A total of 241 shots were fired in the entire survey and the results of the survey are shown illustratively in the form of flank profiles, Figures 3, 4, and 5. The positions of the well with respect to the flanks of the dome are shown and the deviation of the wells from the vertical were determined from the Sperry-Sun test in planes perpendicular to flanks of the dome in the case of the B. & O. well No. 4 and Cade "B" well No. 1. The Smith well No. 10 is shown on the flank profile, Figure 4. Its duration was determined by a seismograph survey, and due to the waves picking up the salt, it is subject to a plus or minus horizontal correction of about 100 feet.

The dotted curve gives the dome profile taken from shallow well logs and data available at the time the survey was started and forms the basis for the flank profile calculation. The solid curve gives the flanks as calculated from the seismograph survey.

The flank profile, Figure 5 of the B. & O. well No. 4, shows the horizontal extent of "mushrooming" or overhang to be 500 feet from the present surface location of the well and below a depth of 4,950 feet.

The flank profile, Figure 3, of the Cade "B" well No. 1, shows the horizontal extent of "mushrooming" to be at least 800 feet from the present surface location of the well and below a depth of 4,880 feet. The exact amount of "mushrooming" could not be wholly ascertained in this well, as the depth of the hole below the "mushrooming" is not great enough to determine the total amount of overhang. Therefore, a dotted profile is shown, which is the minimum horizontal extent of the overhang.

The flank profile, Figure 4, of the Smith well No. 10 shows the horizontal extent of the "mushrooming" to be at least 800 feet from the present surface location of the well and below a depth of 4,700 feet.

The seismic vertical profile may easily reflect out under the overhanging cap by as much as several hundred feet without showing definite indication on the seismograph, and there may be some "fingering" of the cap rock overhanging the dome proper. But, considering the depth of the overhang in the three wells surveyed, it shows a decrease in depth to the point of "mushrooming" as the dome is followed around the flanks in a counter-clockwise direction from the B. & O. well No. 4.

Figures 6, 7, and 8 are cross sections drawn through the same lines from each of the shot wells that formed the basis of the seismograph flank profiles. Figures 6, 7, and 8 were obtained exclusively from geological data and from subsurface contours based on the cap rock which were drawn from well data and geological reasoning. The results as obtained from Figures 6, 7, and 8 check surprisingly well with the seismograph data which are represented on Figures 3, 4, and 5.

SUBSURFACE GEOLOGY

The cap rock at High Island is divided into what might be called a series of caps.[9] At the base of the series, or directly above the salt, the cap is uniformly massive anhydrite. The anhydrite passes upward into massive anhydrite and gypsum, characterized by an abundance of calcite as a secondary mineral invading the gypsum. There is also a separate calcite cap above the anhydrite-gypsum. It is to be noted, however, that the calcite cap was not found in all of the wells that encountered or penetrated the cap rock. On the west, southwest and south flanks the calcite cap rock was found to occur in thicknesses ranging from a few feet to 25 feet, but on the northwest flank this calcite cap rock was not encountered. It was a practice of the Company to core the top of the true cap rock to determine its characteristics and in the wells on the northwest the anhydrite-gypsum cap rock was not found. The calcite cap rock is characterized by white to colorless hexagonal crystals so formed as to appear massive. A sample would easily break by a blow from a hammer and separate after breakage into innumerable crystals. However brittle the sample seemed to be, the mass itself was extremely hard to drill and at times would necessitate a change in bits before it could be penetrated. A large amount of anhydrite is distributed in the ***gypsum*** cap rock and in places the anhydrite is dominant as banded streaks, from several inches to 10 feet in thickness, intermingled with the gypsum.

[9] M. T. Halbouty, "High Island Dome, Galveston County, Texas," *Bull. Amer. Assoc. Petrol. Geol.*, Vol. 16, No. 7 (July, 1932), pp. 701–02.

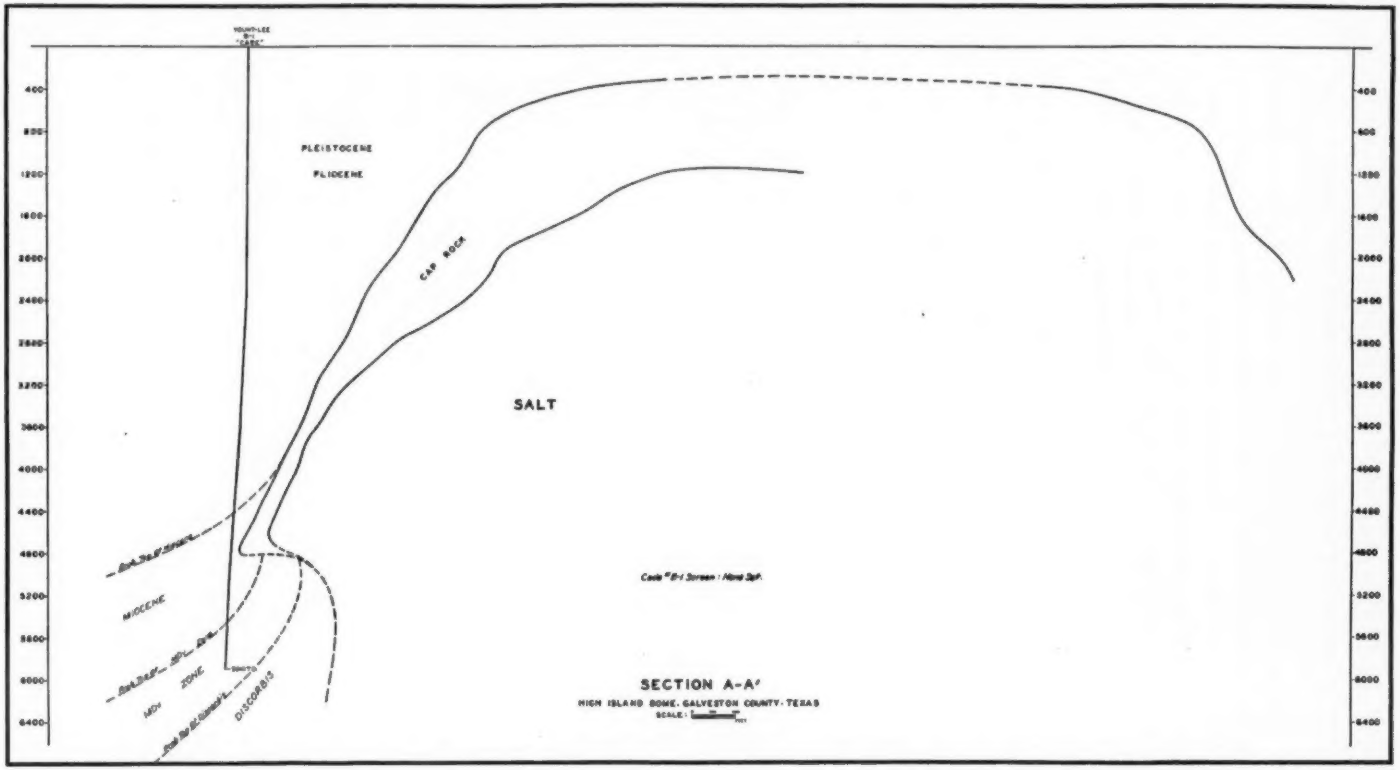


FIG. 6.—Cross section AA' from southwest flank (left) to northeast (right).

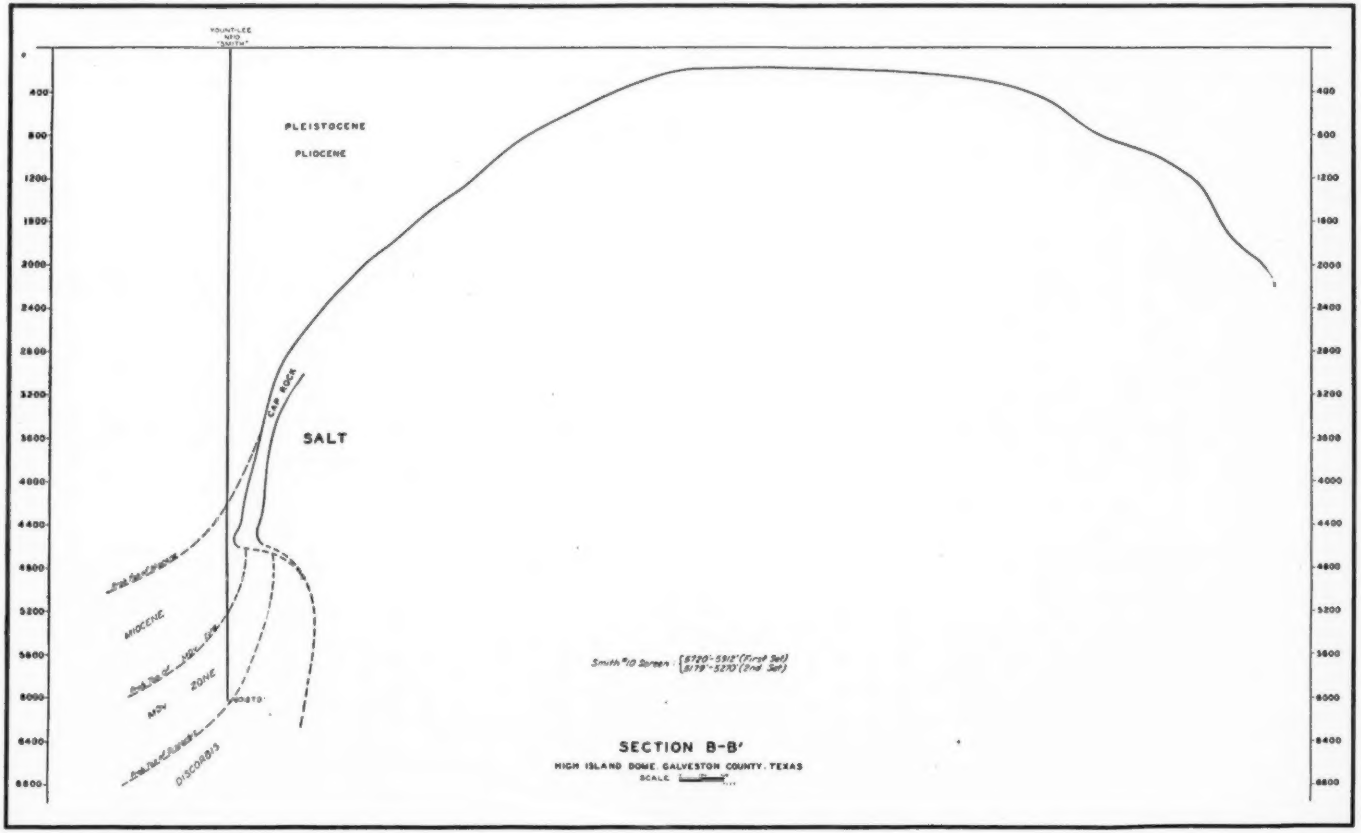


FIG. 7.—Cross section *BB′* from south flank (left) to northeast (right).

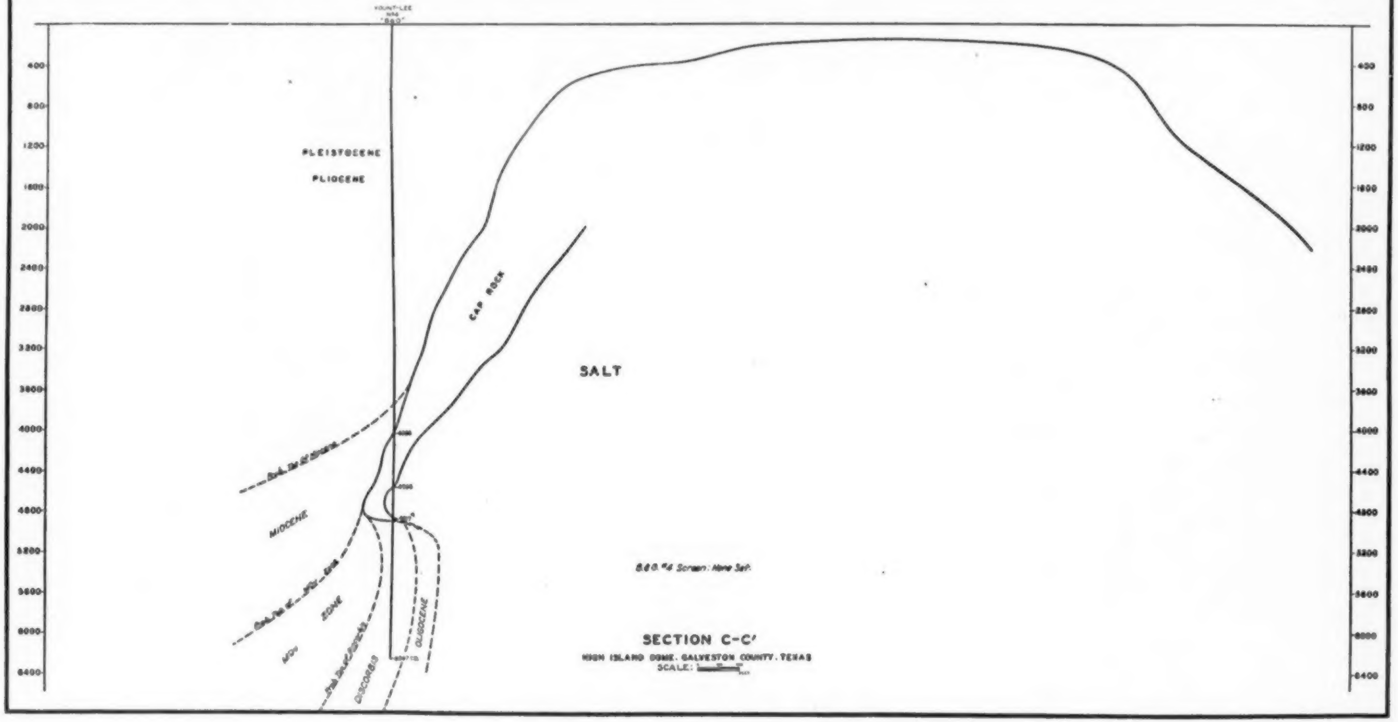


FIG. 8.—Cross section CC' from northwest flank (left) to southeast (right).

However, the gypsum is very prominent, occurring in soft, white, compact masses. The thickness of the gypsum cap rock is from 10 feet to 125 feet.

The anhydrite cap rock is the dominant member of the cap-rock series. This material overlies the salt and is massive and compact with a texture that may be termed marble-like. The color of the average anhydrite at High Island is a deep gray that when held in the sunlight seems to change to light blue. The anhydrite is relatively pure. However, at points just bordering the extreme outer edges of the flank of the cap rock, the anhydrite is associated with small streaks of banded impure limestone and sandstone. This sandstone is very impure, carrying a matrix similar to that found in the gouge zone.

The thickness of the entire anhydrite-gypsum-calcite cap rock is from 75 to 675 feet. In some places the anhydrite alone is more than 400 feet thick. These materials are referred to as the true cap rock of the dome.

The word *true* is used because above the true cap rock is a hard sand and lime rock which is nothing more than an indurated, well cemented, calcareous sandstone ranging from 200 feet to 1,300 feet in thickness, which has been commonly termed the false cap rock of the dome. This material is uniform in character and rarely has shale or sand breaks intermingled. At first glance at a core of this sandstone, the physical texture and appearance is similar to that of true anhydrite cap rock and its well cemented matrix makes drilling in it very difficult. This false cap rock caused the abandonment of wells drilled in the early years of attempted development at High Island, as in some cases it was mistaken for the true cap rock, and non-productive cap rock in those days meant the abandonment of wells.

Many cavities are found in the false and true cap rock at High Island. These cavities are very troublesome to fill or prepare for the continuation of successful drilling. However, in four years the Yount-Lee Oil Company successfully handled 34 cavities by scientific application of mud and cement control.

The average total thickness of both false and true cap rock, if taken on the super-dome structure, is approximately 2,000 feet. However, as the flanks of the dome are approached, the thickness becomes less, to a minimum of approximately 100 feet. The false cap rock either is absent or is present in only very small thicknesses (averaging 25 feet) on the extreme flanks of the dome.

The salt at High Island was found to be extremely hard on the outer edges, this hardness decreasing towards the center of the dome.

Cores were taken in the salt in every well that the Yount-Lee Oil Company drilled into or through, and on analysis the salt was found to be from 97 per cent to 98.7 per cent pure. The impurities were greater near the extreme flanks of the salt, mostly in the form of anhydrite crystals. Some quartz was also noted in salt near the outer flanks and adjoining the gouge zone.

As much as 1,300 feet of salt was drilled through into lower producing formations in the field. In the Yount-Lee Company's Mathis well No. 1, on the south flank, the salt was penetrated three times. False cap rock was found from 2,274 feet to 2,546 feet; true cap rock, from 2,546 feet to 3,110 feet; and below the cap rock 25 feet of salt was penetrated; below the salt 40 feet of true cap rock, then 51 feet of true salt with 20 feet of cap rock below, and then 1,271 feet of salt, before entering the Vicksburg formation. This well is illustrated in Figure 20.

The gouge zone is one that lies underneath the salt overhang and occurred chiefly in wells drilled on the northwest, west, and southwest flanks. Very little gouge-zone material was found under the salt overhang on the south and southeast flanks. This zone consists predominantly of products of secondary mineralization varying from well cemented rock to a loosely consolidated mass.

It is evident that the overlying and underlying formations have been greatly affected by the movement producing the upthrust and overhang of the dome, as the formation in all of the overhang wells was badly broken above the cap rock and out to the flanks. A gouge zone and broken and faulted formations underlying the overhang were evident.

In the Yount-Lee Oil Company's Mathis well No. 2 on the south flank, illustrated in Figure 19, the true cap rock was found from 2,962 feet to 3,269 feet, and then salt to 3,760 feet before entering a gouge zone 104 feet thick, consisting of a consolidated mixture of sandstone, shale, cap rock, and salt. The *Foraminifera* found in this gouge zone were of Vicksburg age. Below the gouge zone 298 feet of Vicksburg formation was penetrated, and underneath that 101 feet of salt, and then Vicksburg formation again. This particular well is a good illustration of the nature of the formations at High Island. After penetrating the overhang, the drill generally encountered, below the salt or the gouge zone, either Miocene or the *MDv* zone. However, in some places the Vicksburg formation was encountered below the overhang. This is clearly illustrated in Figures 15, 18, 19, 20, and 23. In one well, namely, the Yount-Lee Oil Company's Cade "B" 2 on the southwest flank, the Whitsett *Foraminifera* of Upper

Jackson age were found in a shale and salt mixture at 4,839 feet and the bottom of the salt was found at 4,866 feet. Below the salt, Miocene formation was encountered.

Faulting of major importance has been definitely detected on the south flank, and a graben of great importance also has been defined on this flank (Fig. 22). Small faults have been detected on the northwest flank on the B. & O. leases and Cade leases. It was not possible, however, to trace their extent and map them definitely. Similar faults are believed to exist on the southwest flank, but they also were not definite enough to trace for mapping purposes. These small faults were located from paleontological data, and could possibly be explained by "thick sections." However, repetitions of definite mineralogical and paleontological guides were clearly distinguished in certain wells. Such faults were not large enough to penetrate down into a separate formation, which would have given definite criteria for their existence. Nevertheless, a hard brecciated zone was present in some wells, furnishing one definite fact indicating the presence of "small faults" on these flanks. These faults are probably radial and all were observed in either the Miocene formation or the *MDv* zone. The majority of these faults are thought to exist on the northwest side and are approximately eight in number.

The graben occurring on the south flank seems to coincide with the topographical depression existing on the surface (Fig. 1). This graben has caused the Yount-Lee Oil Company considerable trouble, as several wells were drilled in its area without any production obtained. After the east fault was definitely detected, which proved the existence of the graben, the company ceased operations within its boundaries, on the theory that the oil had migrated to the upthrust formation on either side of the graben.

A peripheral fault has been theoretically placed to extend from the northwest flank around to the southwest flank and reasons for so placing the fault are clearly indicated by the upthrow of the cap rock and formations away from the dome (Figs. 9–15). Figure 12 shows the cap rock upthrust as affected by this fault. In two wells, the Yount-Lee Oil Company's Cade No. 30 and Cade No. 28, drilled in line, the latter well being located 300 feet away from the dome, the cap rock and formations were topped at intervals of depth clearly indicating a fault. Wells drilled as shown in Figures 13 and 14 also furnished similar evidence and, as these wells were drilled from the northwest to the southwest flank and a similar condition existed completely around the peripheral area, it was concluded that such a fault would be a peripheral, not a radial fault. However, there is a possibility

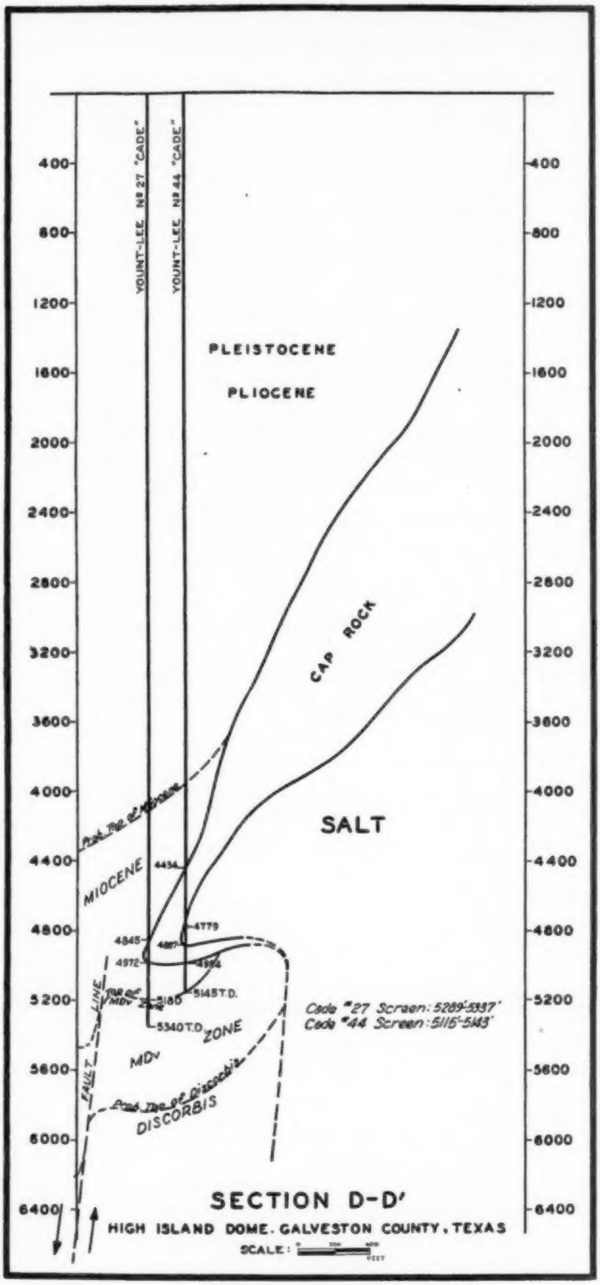


FIG. 9.—Cross section *DD'* from northwest flank (left) toward southeast (right).

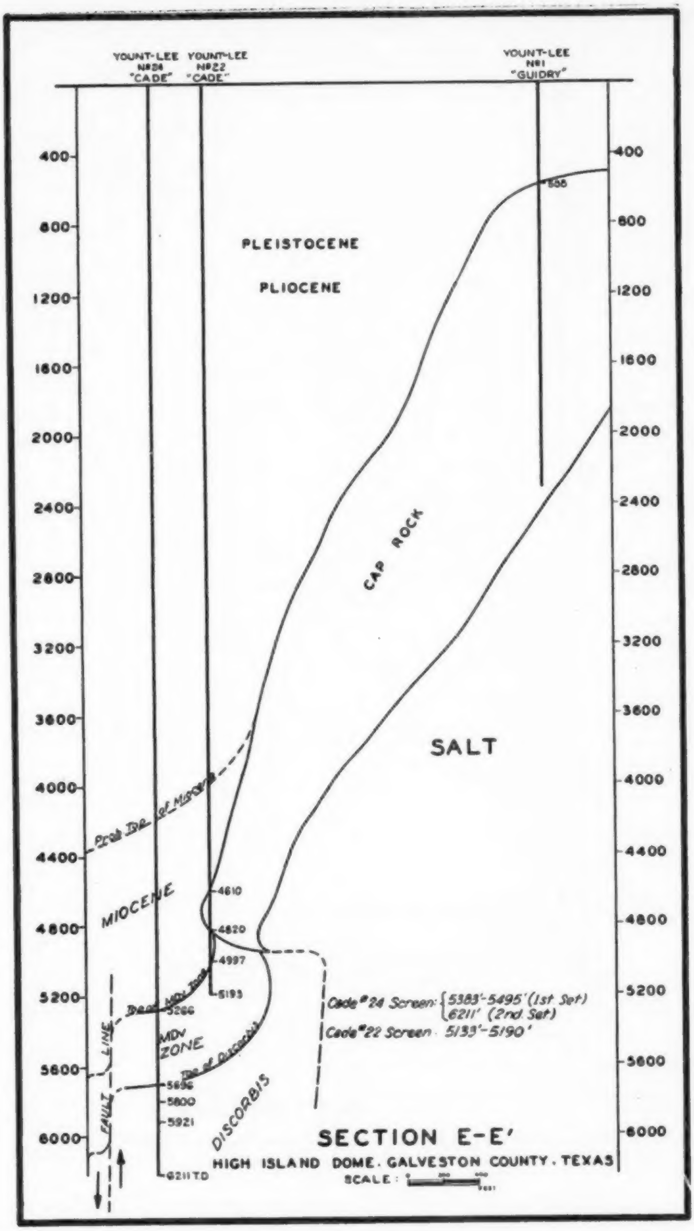


FIG. 10.—Cross section *EE'* from northwest flank (left) toward northeast (right).

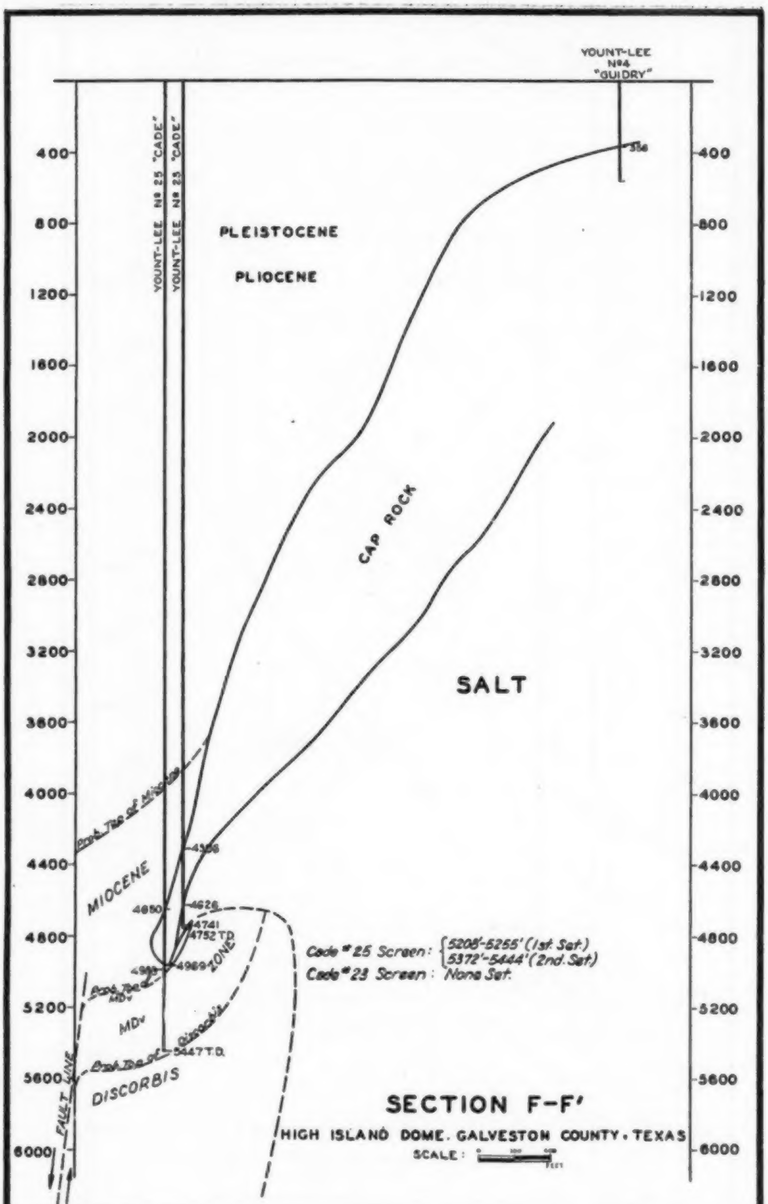


Fig. 11.—Cross section *FF'* from northwest flank (left) toward east (right).

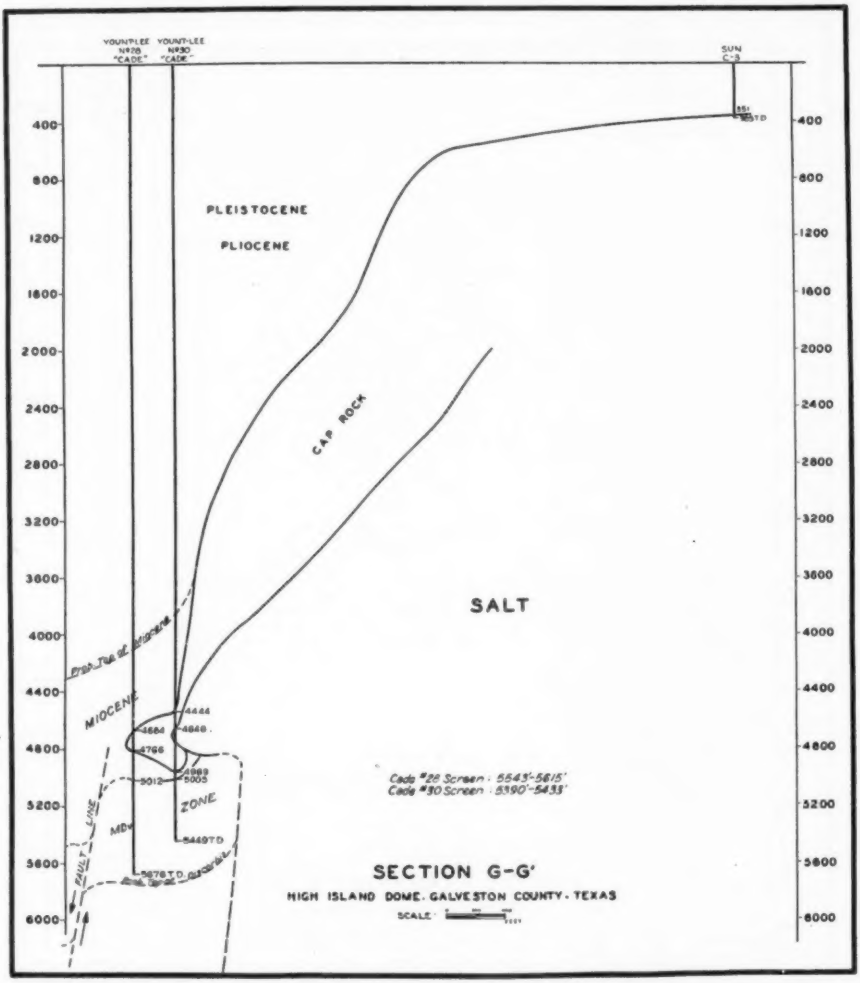


FIG. 12.—Cross section *GG'* from northwest flank (left) toward northeast (right).

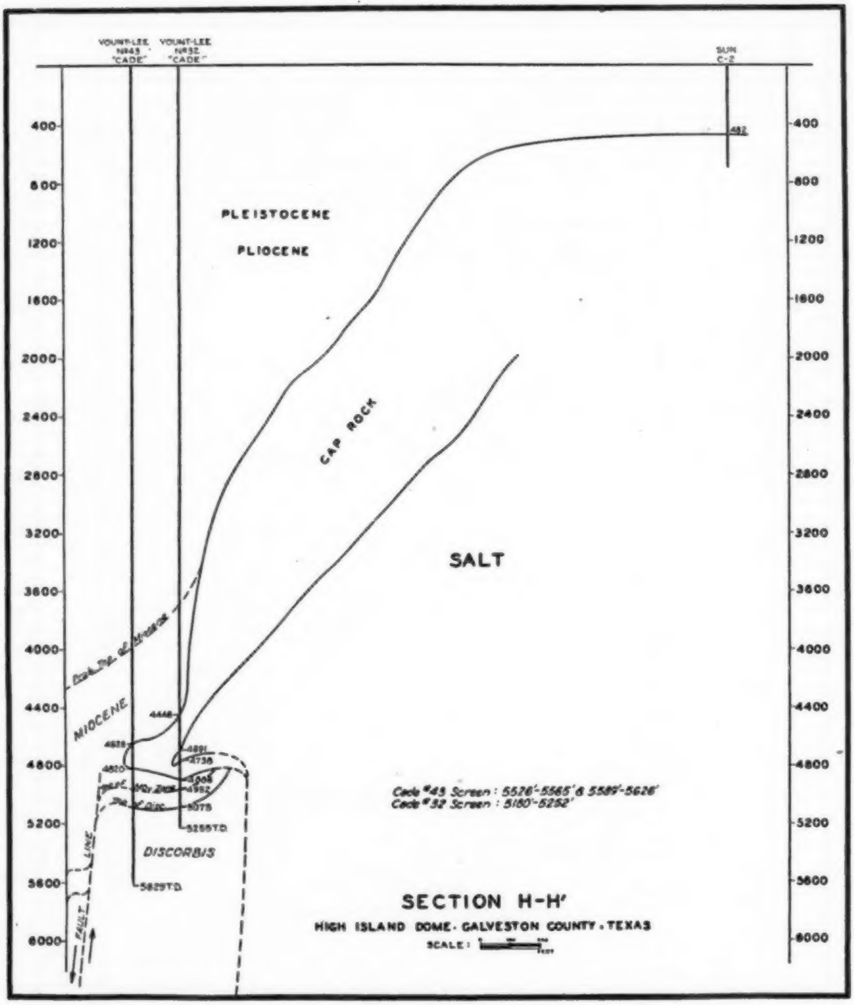


FIG. 13.—Cross section *HH'* from west flank (left) toward northeast (right).

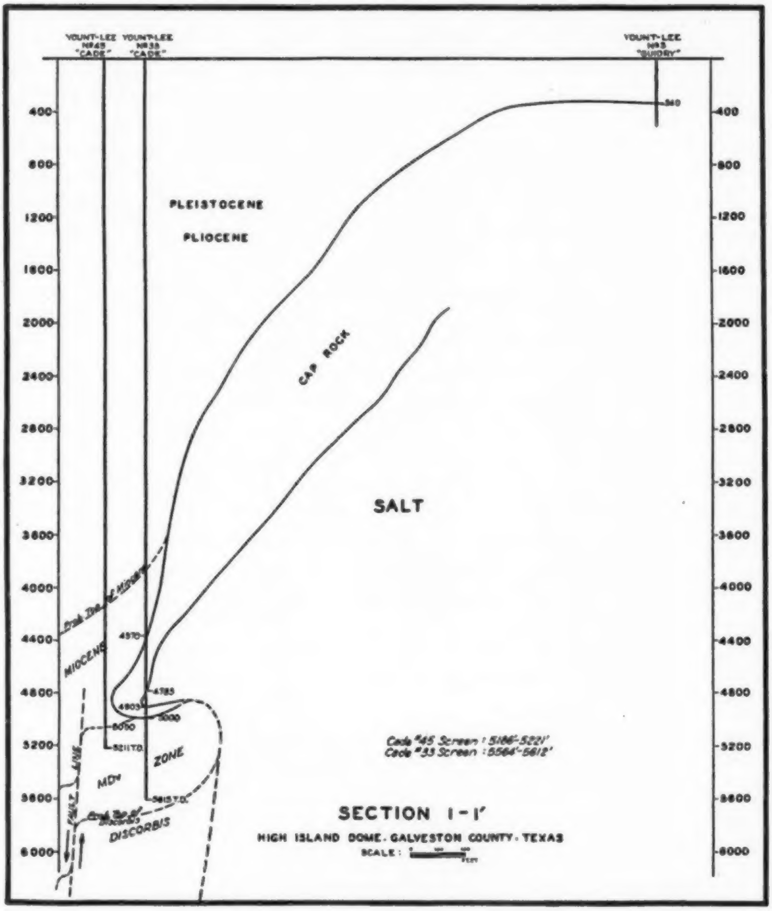


FIG. 14.—Cross section *II'* from west flank (left) toward northeast (right).

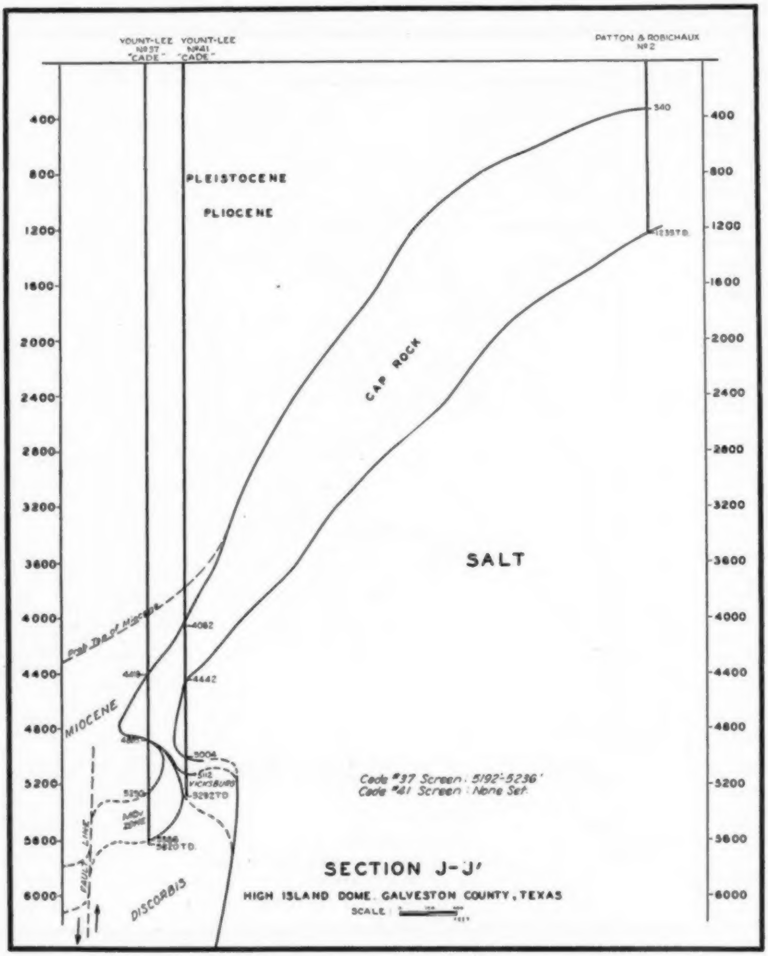


FIG. 15.—Cross section *JJ'* from southwest flank (left) toward northeast (right).

that at the beginning and end of this fault there are two radial faults that either join, or are connected with or caused by, this peripheral fault.

The Oligocene formation as a whole is greatly uplifted and distorted. The *Discorbis* zone in some areas has very little dip (Fig. 13), but in other areas the zone dips almost vertically. In one well, the Yount-Lee Oil Company's B. & O. No. 4, the *Discorbis* zone was penetrated 1,330 feet without a break, and cores taken from this zone showed dips between 88 degrees and 90 degrees (Fig. 8). No *Heterostegina* zone material has yet been found at High Island. This condition might be explained by one of two theories, (1) that the zone was completely pinched out during the uplift of the dome, and (2) that the dome was protruding above the surface during *Heterostegina* deposition so that the shallow *Heterostegina* sea did not rise high enough to deposit its material. The *Vicksburg*, *Marginulina*, and *Discorbis* seas were of sufficient magnitude to deposit their materials over the rising mound, and further upthrust of the dome raised those zones into their present positions. The *Marginulina* zone was found in only one well, the Yount-Lee Oil Company's Smith No. 17, located on the southwest flank. This well proves the existence of the zone. The zone was not picked up in other wells because the depths of drilling and the locations of the wells were not favorable for finding other *Marginulina* deposits. Figure 17 illustrates the probable condition existing in the Oligocene. The Vicksburg formation might have been carried completely up and along the flanks of the dome, finally resting beneath the overhang as shown in Figures 15, 18, 19, 20, and 23; or, it may be completely overlapped from the lower depths, extending alongside of the dome, then finally swinging underneath the overhang, as shown in Figure 17.

The overhang at High Island is not wholly of salt, as the cap rock extends beyond the edge of the salt to form a separate overhanging body (Figs. 6–20, 23–25). In the development of the field, the Yount-Lee Oil Company was as much interested in the cap-rock overhang as in the salt overhang, as production was as prolific under one as under the other. Of 51 wells drilled through the combined overhanging masses, 25 were drilled through the cap-rock overhang. Therefore, with 26 salt-overhang wells, the ratio between the two masses was about the same. Table II shows the wells drilled through either the salt or the cap-rock overhang or both, at High Island.

Figure 26 is a contour map of the cap rock with an outline of the 4,800-foot contour of the salt which breaks off into the 3,400-foot contour because of the effect of the faulting on the south. This map

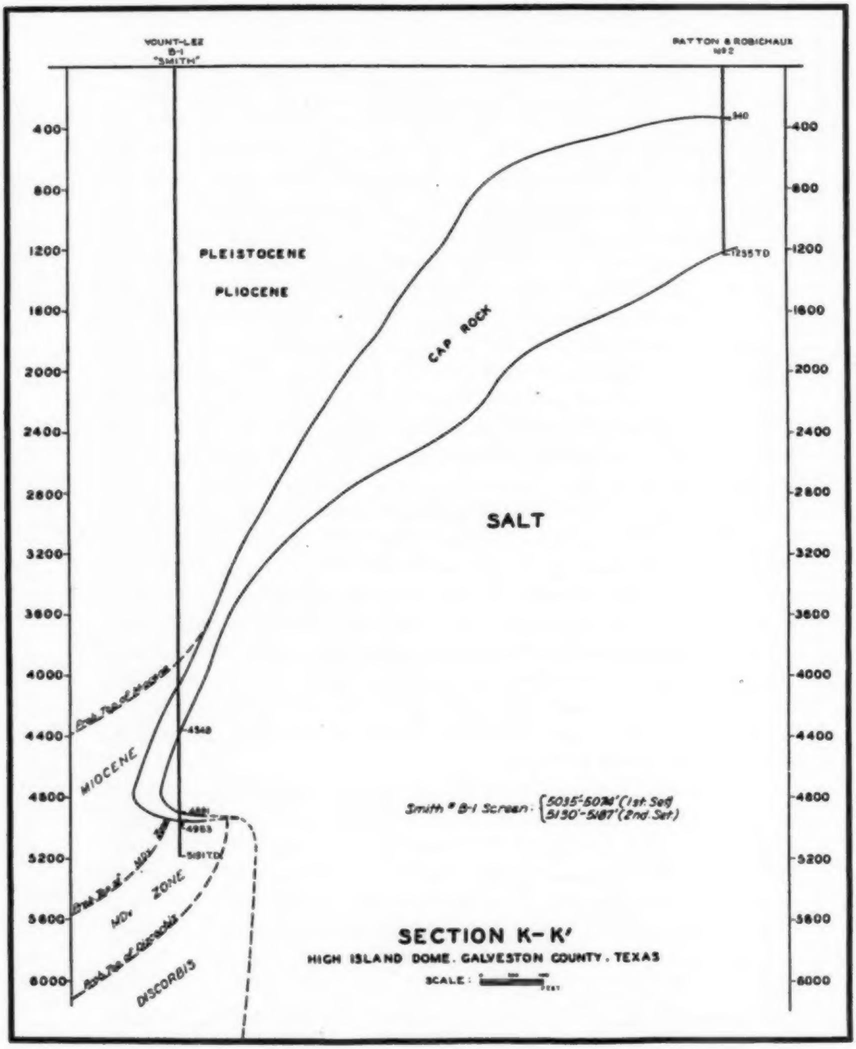


FIG. 16.—Cross section *KK'* from southwest flank (left) toward north (right).

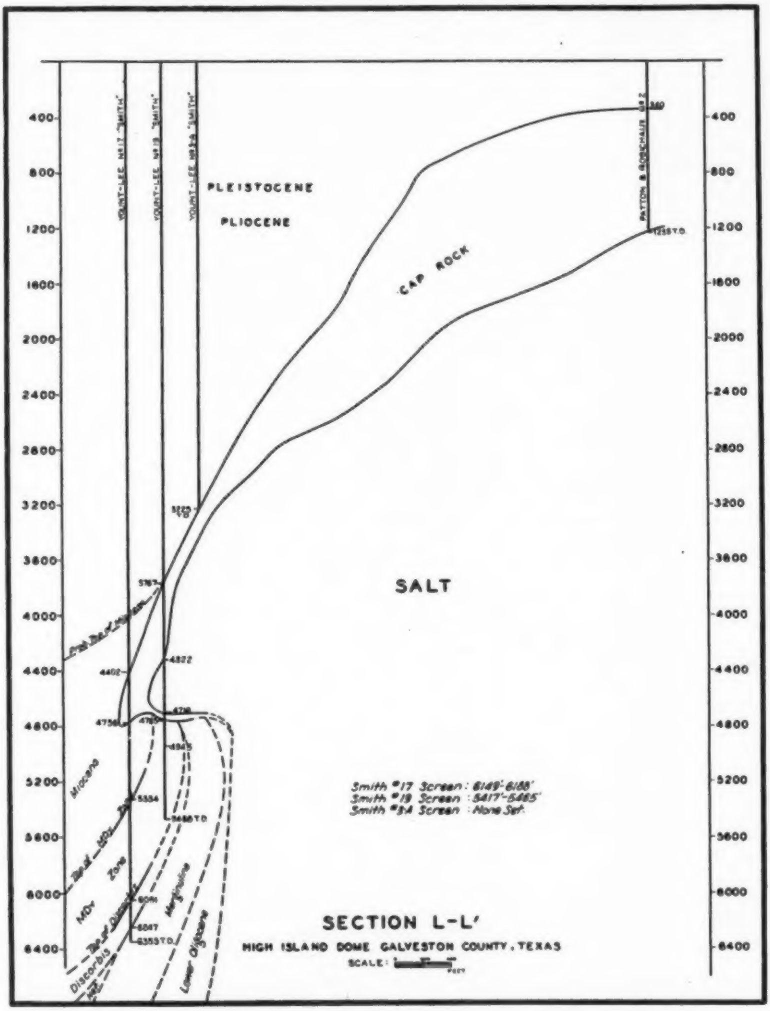


FIG. 17.—Cross section *LL'* from south flank (left) toward north (right).

TABLE II

Tabulation of Wells Drilled through Overhanging Cap Rock and/or Salt at High Island

(Depths in feet; production in barrels)

Company, Lease and Well No.	*True Cap Rock*	*Salt*	*Total Depth*	*Flank*	*I.P.*
Yount-Lee Oil Co.					
Mathis 1	2,546–3,110	3,110–3,135			
	3,135–3,165	3,165–3,216			
	3,216–3,236	3,236–4,507	4,608	S.	Aban.
2	3,057–3,269	3,269–3,760			
		4,052–4,153	4,157	S.	Aban.
Gulf Co.					
Smith 8	3,139–3,282	3,282–3,327	3,454	S.	Aban.
Yount-Lee Oil Co.					
Smith 11	4,068–4,198	None	4,623	S.	1,500
12	3,950–4,236	None	5,791	S.	1,488
13	2,919–3,571	3,571–3,761			
	3,761–3,834	3,834–4,620	4,621	S.	Aban.
14	4,180–4,415	None	5,066	S.	960
15	4,323–4,595	None	5,203	S.	870
17	4,402–4,756	None	6,353	S.	230
19	3,767–4,322	4,322–4,716	5,468	S.	360
20	4,134–4,329	None	4,857	S.	720
21	3,900–4,120	None	5,312	S.	720
22	3,805–4,382	4,382–4,607	4,843[1]		
	3,805–4,397	4,397–4,574	5,913[2]	S.	120
23	4,090–4,469	4,469–4,538			
	4,538–4,588	4,588–4,594		S.	
Smith "B" 1	4,133–4,348	4,348–4,891	5,191	S.W.	500
Stewart 1	2,201–2,952	2,952–3,622	4,237	S.E.	120
2	2,315–3,058	3,058–3,347	4,614	S.E.	520
Spencer 2	3,915–4,396	None	5,723	S.	1,150
Nellie B. League 2	3,973–4,085	None	4,515	S.	600
Loustalot A1	2,495–3,028	3,028–3,585	4,095	S.E.	545
A2	3,110–3,146	3,146–4,219	4,600	S.E.	Aban.
B & O 1	4,845–4,900	None	6,193	N.W.	483
2	4,259–4,618	4,618–4,933	6,117	N.W.	65
3	4,884–5,147	None	6,500	N.W.	400
4	4,086–4,565	4,565–4,917			
	4,917–4,923	4,923–4,946	5,980[1]		
	4,090–4,570	4,570–4,935	6,249	N.W.	Aban.
"B" 1	4,327–4,448	None	6,181	N.W.	Aban.
"B" 2	3,426–4,347	4,347–4,931	5,478	N.W.	Aban.
Cade 21	4,555–4,778	4,778–4,821	5,077	N.W.	700
22	4,610–4,820	None	5,193	N.W.	525
23	4,306–4,626	4,626–4,741	4,752	N.W.	Aban.
25	4,650–4,969	None	5,447	N.W.	403
26	4,851–4,968	None	5,328	N.W.	1,149
27	4,845–4,973	None	5,349	N.W.	1,603
28	4,664–4,766	None	6,109	N.W.	726
29	4,086–4,275	None	5,266	N.W.	1,005
30	4,544–4,646	4,646–4,655	5,553	N.W.	1,150
31	4,388–4,754	None	5,705	N.W.	1,848
32	4,446–4,691	4,691–4,738	5,255	N.W.	702
33	4,370–4,783	4,783–4,903	5,615	W.	1,035
34	4,630–4,978	None	5,834	W.	126
35	4,700–4,878	None	5,419	W.	339
36	4,685–5,151	None	5,382	S.W.	1,028
37	4,418–4,885	None	5,620	N.W.	548
38	4,665–5,020	None	5,713	S.W.	Aban.
39	4,295–4,568	4,568–4,968	5,523	S.W.	412
40	4,190–4,635	4,635–4,936	5,019[1]		
		4,889–4,936	5,699[2]	S.W.	
41	4,062–4,442	4,442–5,004	5,292	S.W.	Aban.
42	4,260–4,579	4,579–4,891	5,837	N.W.	100
43	4,628–4,820	None	5,629	N.W.	407
44	4,434–4,779	4,779–4,882	5,145	N.W.	363
"B" 2	4,366–4,470	4,470–4,866	5,268	S.W.	350

[1] First drilling.
[2] Second drilling.

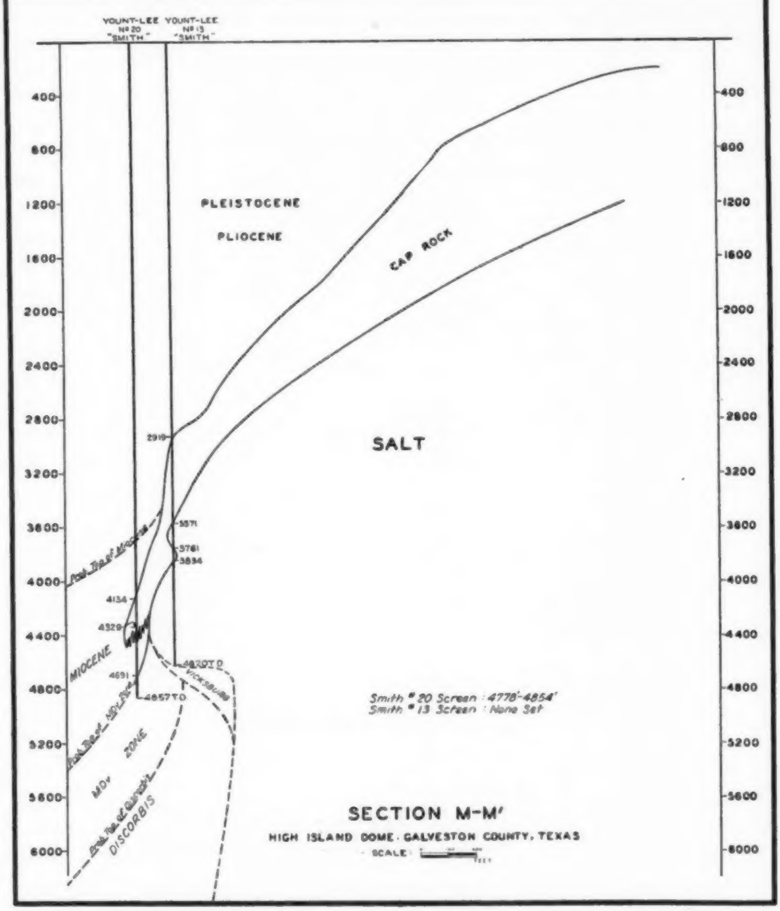


FIG. 18.—Cross section *MM'* from south flank (left) toward north (right).

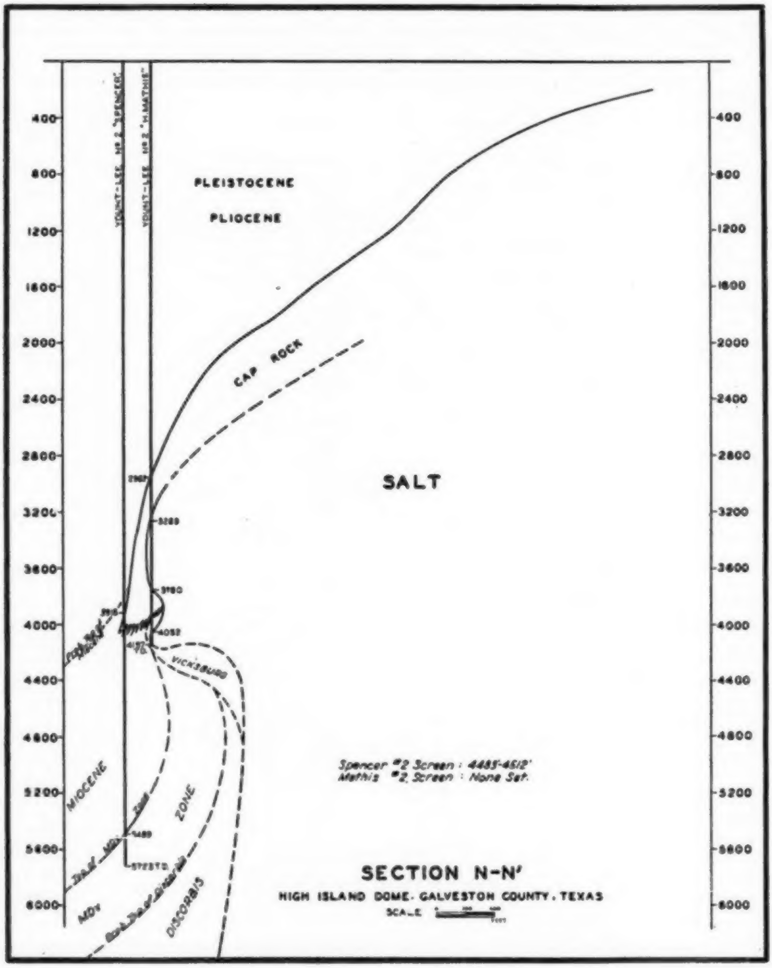


FIG. 19.—Cross section *NN'* from south flank (left) toward north (right).

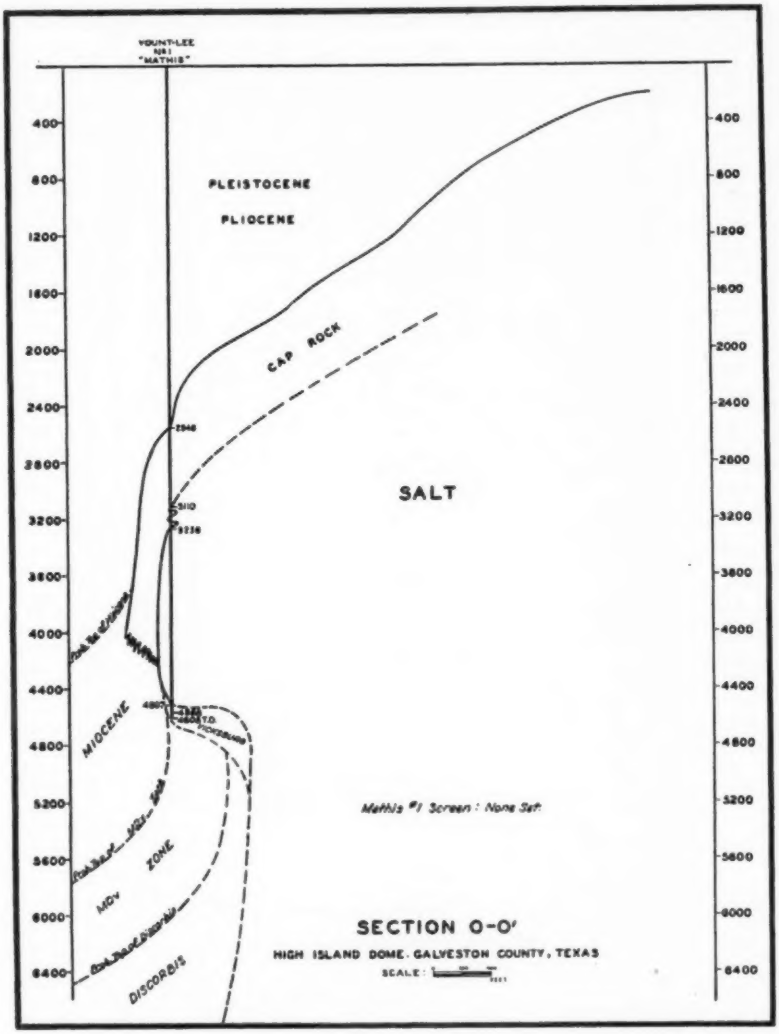


Fig. 20.—Cross section *OO'* from south flank (left) toward north (right).

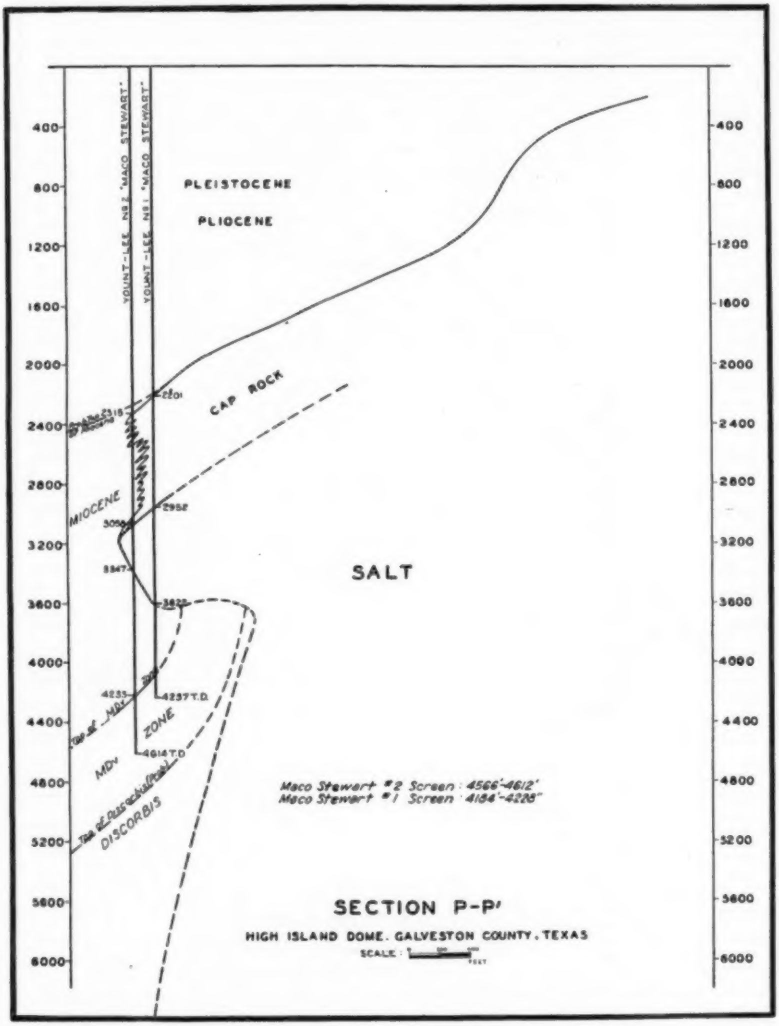


FIG. 21.—Cross section *PP'* from southeast flank (left) toward north (right).

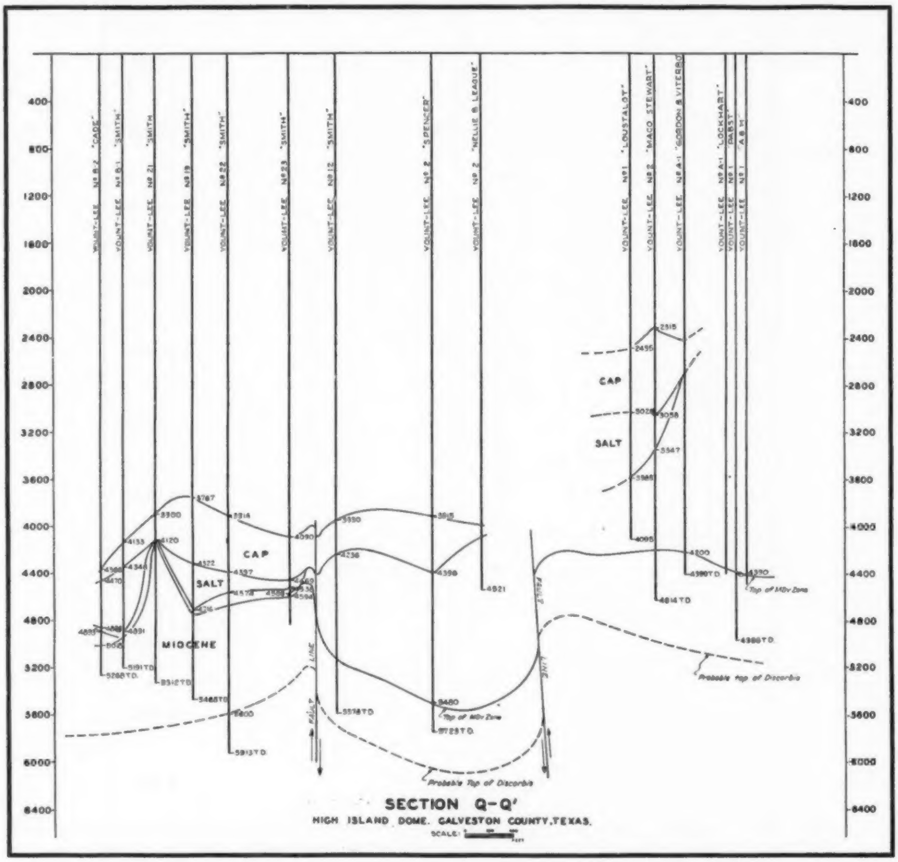


FIG. 22.—Cross section QQ' along southwest, south, and southeast flanks of dome showing faulting.

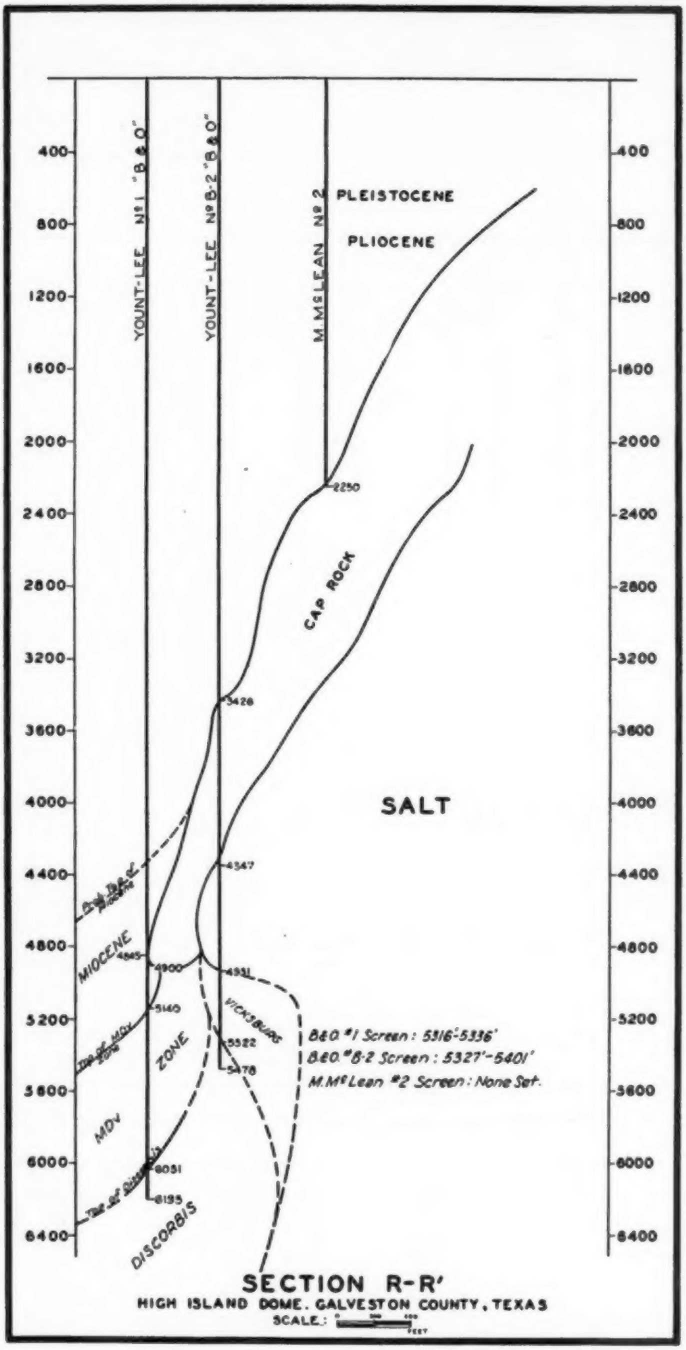


FIG. 23.—Cross section *RR'* from northwest flank (left) toward east (right).

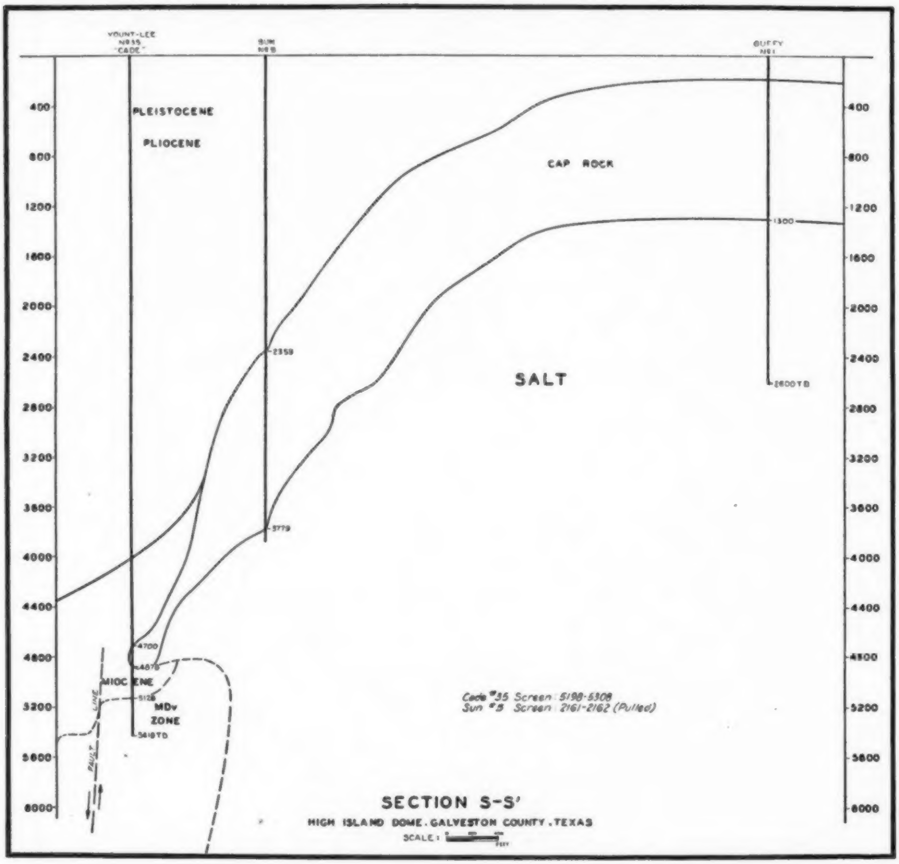


FIG. 24.—Cross section *SS'* from southwest flank (left) toward east (right).

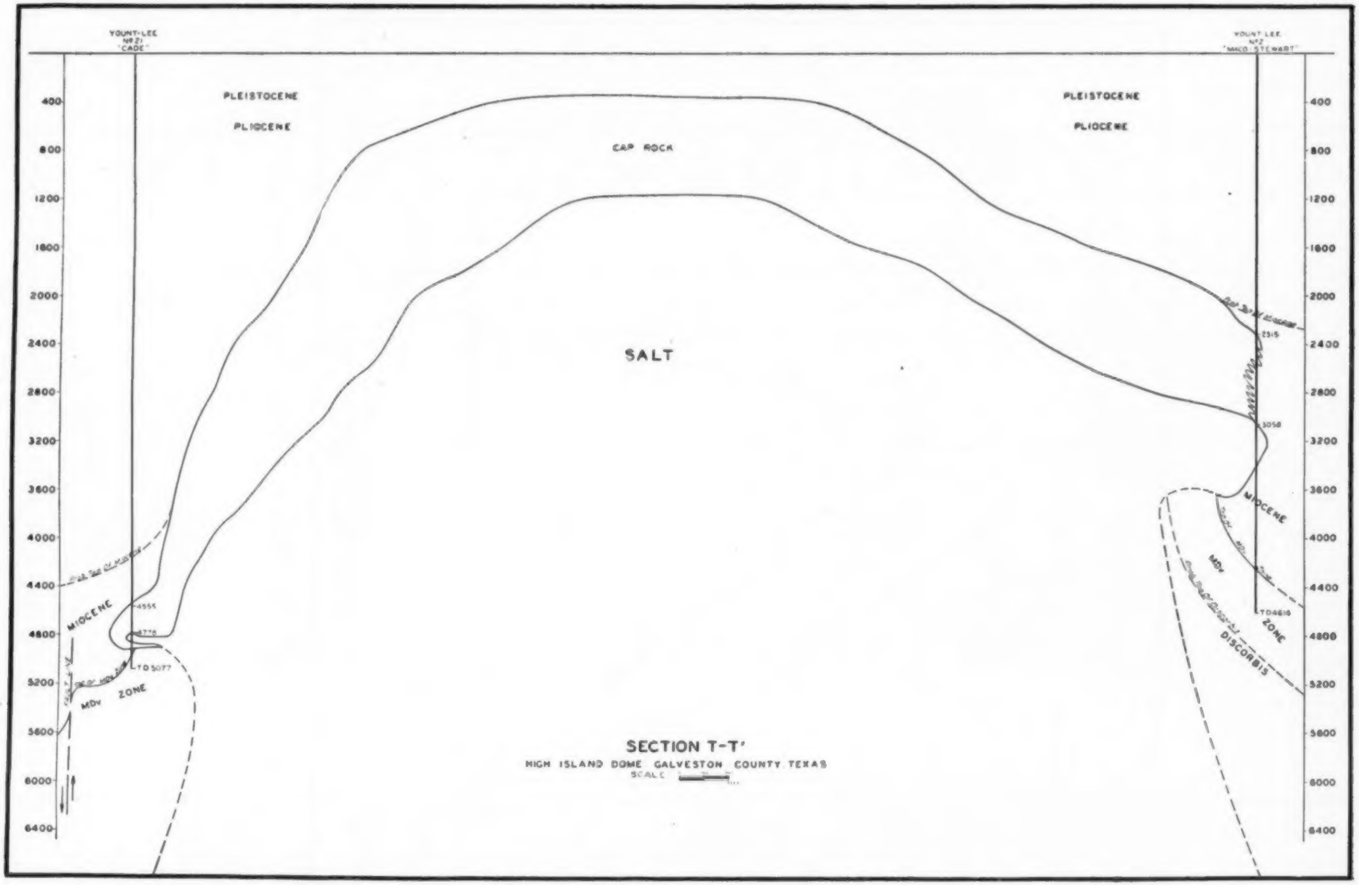


FIG. 25.—Cross section *TT'* from northwest flank (left) to southeast flank (right) showing difference in salt elevation.

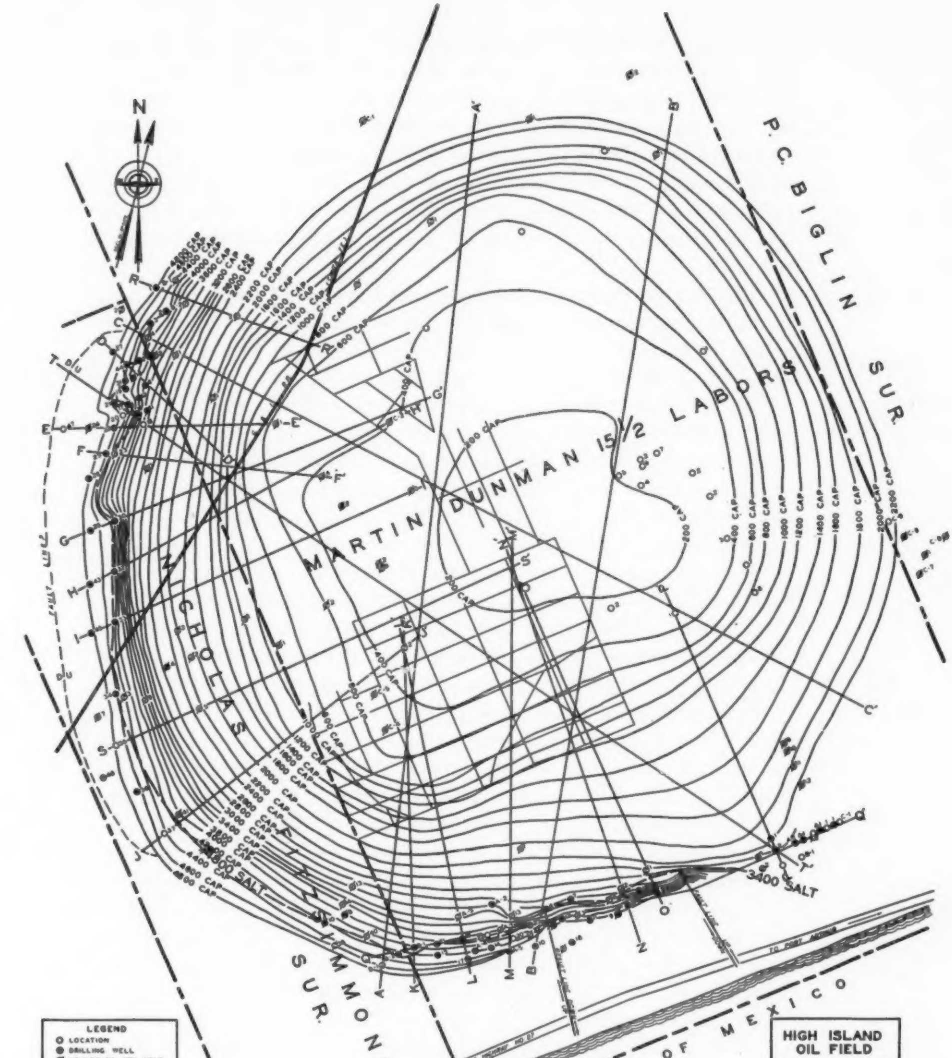


Fig. 26.—Contour map of top of cap rock with outer salt contour showing horizontal extent of overhang from cap rock.

also shows the theoretical peripheral fault, the graben, and the section lines from which the figures were drawn. The contour lines are based only on available data and for that reason the entire dome was not contoured. The data were obtained principally from drilling, which lends to the map and its construction reasonable accuracy. The small faults mentioned above can be detected to some extent by the convergence of the cap-rock contour lines on the northwest flank. It is in that area in the lower formations that these faults were thought to occur.

The salt contour on this map marks the outer flanks of the salt. From this salt line one can observe the overhanging or mushrooming extent horizontally from the outer edges of the cap rock to the salt. This clearly illustrates the separate structural condition and its importance to production that is caused by the extension of the cap rock to form a greater overhang.

Figures 6, 7, and 8 were made from geological data. Very few or slight changes were necessary on the figures to reconcile them with the geophysical data illustrating the reasonable accuracy of both conclusions, as far as the present data are concerned.

Figure 27 is a map showing the contours based on top of the salt. This map is based entirely on available drilling data.

It is also interesting to note the nose convergence of the salt on the northwest flank which corresponds to the cap rock and further strengthens the "many-small-faults" idea as applied to that flank.

From geological data obtained from the drilling of the wells at High Island a definite conclusion was reached that as the dome is followed around the flanks in a counter-clockwise direction from the B. & O. lease on the northwest side of the dome, the points of mushrooming decrease in depth; in other words, from the northwest to the west and to the south flanks the dome becomes irregular in depth in that the northwest flank is considerably lower than the south flank. The top of the salt on the south and southeast sides is 1,500 feet higher than it is on the northwest side, and the point of overhang on the south is 300 feet and on the southeast 1,600 feet higher than it is on the northwest side. This difference in elevation of the salt and overhang on the northeast and southeast sides is shown by comparing Figure 13, which is a cross section of the dome, on the northwest side, with that of Figure 21, which is a section of the southeast flank.

Figure 25 is a cross section of the dome from the northwest flank to the southeast flank. This cross section shows the difference in elevation of the salt on either flank. Such a difference gives the dome a lop-sided appearance, with the central axis dipping toward the south.

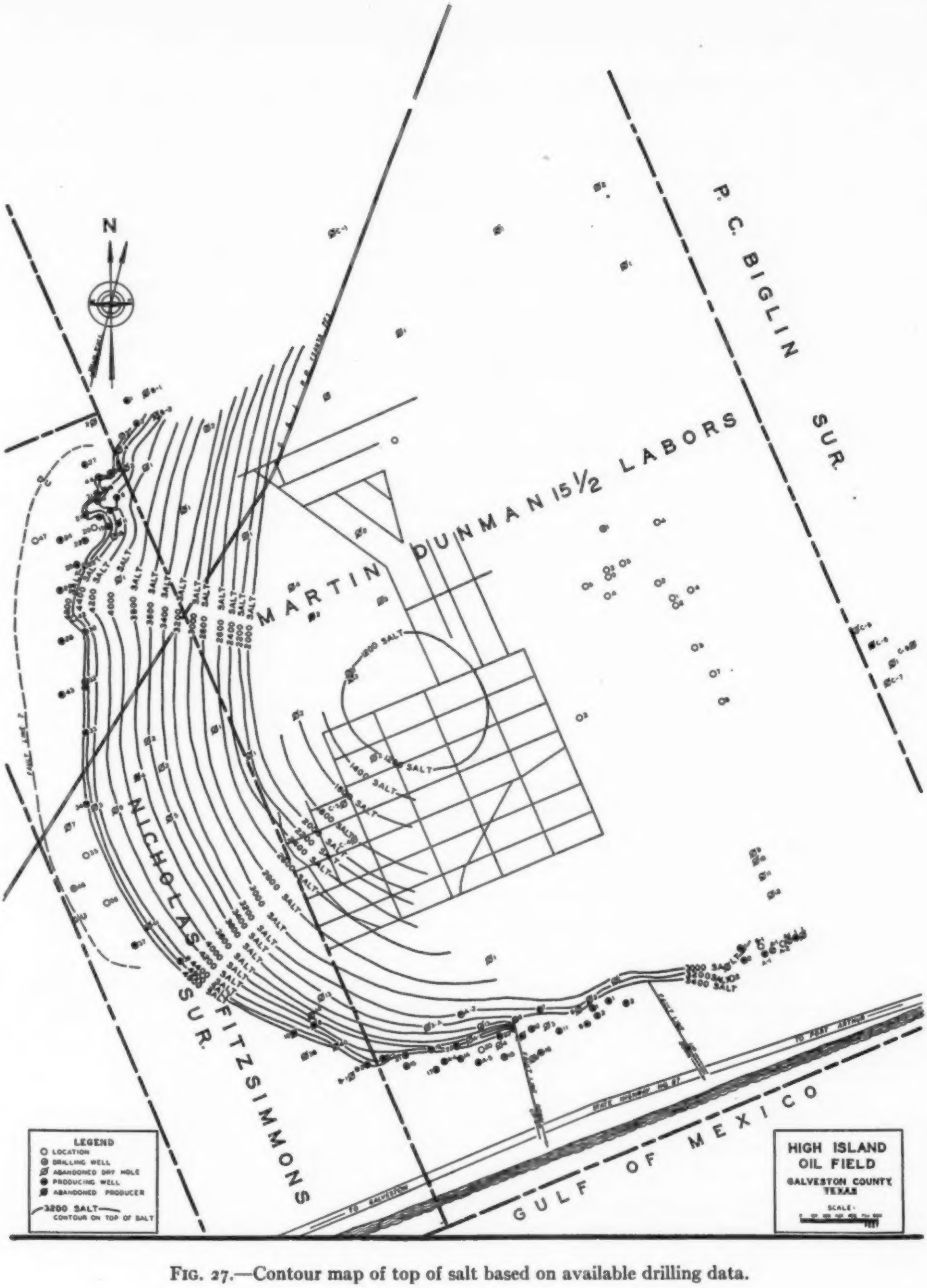


FIG. 27.—Contour map of top of salt based on available drilling data.

On the basis of available data, the horizontal extent of the mushrooming on the south and southwest flanks seems to be the same, or approximately 800 feet. The northwest flank has a horizontal mushrooming extent of approximately 500 feet.

As far as the southeast flank is concerned, the horizontal extent of the overhang has been determined by drilling to be approximately 250 feet; however, it is the writer's belief that the horizontal extent of the overhang on this flank will eventually be proved to be greater than on any other flank at High Island. Production on the southeast flank is much more prolific than on any other flank, the main producing horizon being in the *MDv* zone.

PRODUCING HORIZONS

Oil in commercial quantities has been produced from the cap rock, the Pliocene formation, the Miocene formation, the *MDv* zone, the *Discorbis* zone, and the *Marginulina* zone. The majority of the wells at High Island are *MDv*-zone wells. Of sixty wells drilled by the Yount-Lee Oil Company, forty at one time or another (as in some cases some were deepened to lower zones), produced from the *MDv* zone. Due to the conditions of deposition of the *MDv* zone, this zone contains a number of sands which are productive. The Yount-Lee Oil Company's Smith 17, which was the only well to have produced from the *Marginulina* zone, was re-set twice after its original setting and eventually produced from the two upper zones: namely the *Discorbis* and the *MDv*. Many wells at High Island were deepened into lower zones when the production in the upper zones became too low for economical recovery. In many cases a well was set in three different sands in the *MDv* zone alone.

The oil at High Island consists of three types of crude: one a low-gravity grade at 24° A.P.I., and its immediate range; one a 34° A.P.I. and its immediate range; and the other a 40° A.P.I., and its immediate range. These three types of crude oil and their analyses are shown in the following tables. The maximum amount of production under proration per day at High Island was 8,500 barrels.

SUMMARY AND CONCLUSIONS

The first overhang producer at High Island was completed in April, 1931, drilled by the Yount-Lee Oil Company. This well proved the existence of an overhang at High Island and productive sands underneath.

The cap rock is divided into a series of caps: namely, a false cap rock above, consisting of hard sand and lime (calcareous sandstone),

and the true cap rock below, consisting of calcite, gypsum, and anhydrite.

The overhang has been proved to be around all of the flanks drilled, or from the northwest, west, south, to southeast. The writer believes that the overhang will prove to extend completely around the dome. The horizontal extent of the generally proved overhang is from 250 feet to 800 feet. This overhang is not wholly one of salt but of cap rock as well. The cap-rock overhang has proved to be as prolific as the salt overhang.

The dome is not entirely symmetrical in shape, as it is elongated north and south and higher on the south than on the north. The axis of the dome dips towards the south.

Faulting has been detected in the lower formations underneath the overhang. The formations, as a whole, below and above the dome, are broken and distorted, and drilling in these broken masses is difficult because of heaving conditions. A graben of major importance has been traced on the south flank. This graben has not produced much oil and operations within its boundaries were abandoned because of migration of the oil to the upthrow sides.

Oil has been produced from the cap rock, Pliocene formation, Miocene formation, *MDv* zone, *Discorbis* zone, and *Marginulina* zone. No *Heterostegina* zone has been encountered at High Island.

Three grades of oil are produced at High Island, varying in A.P.I. gravity from 24 to 44 degrees.

The *MDv* zone is a new zone described by the writer as belonging in the Lower Miocene. This zone in reality is a gradation between the marine *Discorbis* zone, Middle Oligocene in age, and the Lower Marine Miocene material. This zone is the most prolific of the producing horizons at High Island.

TYPE "A" OIL

SUMMARY

A.P.I. gravity	24.0
O.C. flash	Water
Fire	Water
Say. univ. vis. at 100°F.	113 Sec.
Say. univ. vis. at 130°F.	69 Sec.
Color	Dark green
Pour	−0°F.
B.S. & W.	2.0%
Sulphur	.22%
Paraffine	.31%
Untreated gasoline (init.–410°F.)	7.92% crude
Untreated light gas oil (410°–530°F.)	25.21% crude
Heavy gas oil (530°F.—60%)	22.62% crude
Lubricating stock	43.90% crude

BEAD TOWER DISTILLATION DATA

	Vapor Temp.	*Liquid Temp.*
I.B.P.	188°F.	276°F.
5%	396°F.	542°F.
10%	446°F.	576°F.
20%	490°F.	618°F.
30%	527°F.	670°F.
40%	558°F.	697°F.
50%	584°F.	738°F.
60%	628°F.	766°F.
70%	—	—
80%	—	—

Final vapor temp. . . . 628°F.
Final liquid temp. . . . 766°F.

DISTILLATION SUMMARY

Cuts at:				
I.B.P.–410°F.	157 cc	7.85% charge and	7.92% crude
410°–530°	500 cc	25.00% charge and	25.21% crude
530°F.—60%	448 cc	22.40% charge and	22.62% crude
Lub. stock	870 cc	43.50% charge and	43.90% crude
Water	18 cc	.90% charge and	— % crude
Loss	7 cc	.35% charge and	.35% crude
TOTAL	2,000 cc	100.00% charge and	100.00% crude

ENGLER DISTILLATION

Untreated Gasoline		*Untreated Light Gas Oil*		*Heavy Gas Oil*	
Per cent of crude	7.92	Per cent of crude	25.21	Per cent of crude	22.62
A.P.I. gravity	40.3	A.P.I. gravity	31.6	A P.I. gravity	27.7
Octane No.	—	Flash	200°F.	Flash	110°F.
		Fire	225°F.	Fire	180°F.
I.B.P.	278°F.	I.B.P.	432°F.	I.B.P.	218°F.
5%	318°F.	5%	442°F.	5%	396°F.
10%	330°F.	10%	452°F.	10%	498°F.
20%	342°F.	20%	460°F.	20%	550°F.
30%	352°F.	30%	468°F.	30%	578°F.
40%	362°F.	40%	474°F.	40%	592°F.
50%	372°F.	50%	480°F.	50%	602°F.
60%	382°F	60%	488°F.	60%	614°F.
70%	390°F.	70%	498°F.	70%	624°F.
80%	401°F.	80%	508°F.	80%	638°F.
90%	418°F.	90%	520°F.	90%	660°F.
95%	422°F.	95%	538°F.	95%	680°F.
END POINT	456°F.	END POINT	552°F.	END POINT	684°F.
RECOVERY	99%	RECOVERY	99%	RECOVERY	99%

Lubricating Stock

A.P.I. gravity	17.7
Say. vis. at 100°F.	2,212 Sec.
Say. vis. at 210°F.	103 Sec.
Flash	315°F.
Fire	425°F.
Pour	22°F.
Per cent of crude	43.90

SUMMARY

A.P.I. gravity	26.9
O.C. flash	Too light
Fire	Too light
Say. univ. vis. at 100°F.	76 Sec.
Say. univ. vis. at 130°F.	58 Sec.
Color	Brownish green
Pour	—0°F.
B.S. & W.	0.2
Sulphur	0.24
Paraffine	0.57
Untreated gasoline (init.–410°F.)	15.98% crude
Untreated light gas oil (410°–530°F.)	22.66% crude
Heavy gas oil (530°F.—60%)	21.45% crude
Lubricating stock	39.71% crude

BEAD TOWER DISTILLATION DATA

	Vapor Temp.	*Liquid Temp.*
I.B.P.	78°F.	182°F.
5%	182°F.	450°F.
10%	347°F.	512°F.
20%	446°F.	578°F.
30%	491°F.	630°F.
40%	541°F.	687°F.
50%	563°F.	737°F.
60%	537°F.	760°F.
70%	—	—
80%	—	—

Final vapor temp.... 537°F.
Final liquid temp.... 760°F.

DISTILLATION SUMMARY

Cuts at:			
I.B.P.–410°F.	316 cc	15.80% charge and	15.98% crude
410°–530°	448 cc	22.40% charge and	22.66% crude
530°F.—60%	424 cc	21.20% charge and	21.45% crude
Lub. stock	785 cc	39.25% charge and	39.71% crude
Water	23 cc	1.15% charge and	— % crude
Loss	4 cc	.20% charge and	.20% crude
TOTAL	2,000 cc	100.00% charge and	100.00% crude

ENGLER DISTILLATION

Untreated Gasoline		*Untreated Light Gas Oil*		*Heavy Gas Oil*	
Per cent of crude	15.98	Per cent of crude	22.66	Per cent of crude	21.45
A.P.I. gravity	50.2	A.P.I. gravity	32.8	A.P.I. gravity	30.5
Octane No.	—	Flash	195°F.	Flash	105°F.
I.B.P.	118°F.	Fire	210°F.	Fire	130°F.
5%	174°F.	I.B.P.	408°F.	I.B.P.	170°F.
10%	194°F.	5%	437°F.	5%	294°F.
20%	228°F.	10%	444°F.	10%	438°F.
30%	248°F.	20%	454°F.	20%	524°F.
40%	289°F.	30%	460°F.	30%	542°F.
50%	312°F.	40%	467°F.	40%	562°F.
60%	332°F.	50%	474°F.	50%	572°F.
70%	353°F.	60%	482°F.	60%	586°F.
80%	372°F.	70%	492°F.	70%	596°F.
90%	396°F.	80%	504°F.	80%	604°F.
95%	420°F.	90%	520°F.	90%	624°F.
END POINT	433°F.	95%	537°F.	95%	647°F.
RECOVERY	98.5%	END POINT	547°F.	END POINT	648°F.
		RECOVERY	99%	RECOVERY	89.5%

Lubricating Stock

A.P.I. gravity	17.4
Say. vis. at 100°F.	2,326 Sec.
Say. vis. at 210°F.	101 Sec.
Flash	365°F.
Fire	440°F.
Pour	+35°F.
Per cent of crude	39.71

TYPE "B" OIL

SUMMARY

A.P.I. gravity	34.1
O.C. flash	Too light
Fire	Too light
Say. univ. vis. at 100°F.	44 Sec.
Say. univ. vis. at 130°F.	38 Sec.
Color	Brownish green
Pour	−0
B.S. & W.	0.1
Sulphur	0.16
Paraffine	1.46
Untreated gasoline (init.–410°F.)	26.86% crude
Untreated light gas oil (410°–530°F.)	25.90% crude
Heavy gas oil (530°F.—60%)	7.48% crude
Lubricating stock	39.66% crude

BEAD TOWER DISTILLATION DATA

	Vapor Temp.	*Liquid Temp.*
I.B.P.	76°F.	162°F.
5%	179°F.	374°F.
10%	267°F.	426°F.
20%	364°F.	506°F.
30%	440°F.	556°F.
40%	484°F.	597°F.
50%	418°F.	643°F.
60%	565°F.	708°F.
70%	—	—
80%	—	—

Final vapor temp. . . . 565°F.
Final liquid temp. . . . 708°F.

DISTILLATION SUMMARY

Cuts at:				
I.B.P.–410°F.	535 cc	26.75% charge and	26.86% crude
410°–530°	516 cc	25.80% charge and	25.90% crude
530°F.—60%	149 cc	7.45% charge and	7.48% crude
Lub. stock	790 cc	39.50% charge and	39.66% crude
Water	8 cc	.40% charge and	— % crude
Loss	2 cc	.10% charge and	.10% crude
TOTAL	2,000 cc	100.00% charge and	100.00% crude

ENGLER DISTILLATION

Untreated Gasoline	
Per cent of crude	26.86
A.P.I. gravity	53.1
Octane No.	—
I.B.P.	144°F.
5%	188°F.
10%	208°F.
20%	236°F.
30%	258°F.
40%	278°F.
50%	300°F.
60%	318°F.
70%	342°F.
80%	360°F.
90%	386°F.
95%	406°F.
END POINT	421°F.
RECOVERY	99%

Untreated Light Gas Oil	
Per cent of crude	25.90
A.P.I. gravity	36.3
Flash	195°F.
Fire	220°F.
I.B.P.	424°F.
5%	442°F.
10%	446°F.
20%	454°F.
30%	458°F.
40%	466°F.
50%	472°F.
60%	479°F.
70%	488°F.
80%	498°F.
90%	514°F.
95%	530°F.
END POINT	536°F.
RECOVERY	99%

Heavy Gas Oil	
Per cent of crude	7.48
A.P.I. gravity	32.7
Flash	225°F.
Fire	285°F.
I.B.P.	—
5%	—
10%	—
20%	—
30%	Cut too small
40%	—
50%	—
60%	—
70%	—
80%	—
90%	—
95%	—
END POINT	—
RECOVERY	—

Lubricating Stock

A.P.I. gravity	22.4
Say. vis. at 100°F.	578 Sec.
Say. vis. at 210°F.	59 Sec.
Flash	345°F.
Fire	390°F.
Pour	50°F.
Per cent of crude	39.66

TYPE "C" OIL

SUMMARY

A.P.I. gravity	40.3
C.C. flash	Too light
Fire	Too light
Say. univ. vis. at 100°F.	42 Sec.
Say. univ. vis. at 130°F.	37 Sec.
Color	Dark green
Pour	0°F.
B.S. & W.	.1%
Sulphur	0.10%
Paraffine	1.72%
Untreated gasoline (init.–410°F.)	37.25% crude
Untreated light gas oil (410°–530°F.)	26.50% crude
Heavy gas oil (530°F.—60%)	No cut crude
Lubricating stock	36.00% crude

BEAD TOWER DISTILLATION DATA

	Vapor Temp.	*Liquid Temp.*
I.B.P.	78°F.	212°F.
5%	210°F.	332°F.
10%	216°F.	364°F.
20%	306°F.	438°F.
30%	366°F.	490°F.
40%	427°F.	538°F.
50%	470°F.	578°F.
60%	520°F.	650°F.
70%	—	—
80%	—	—

Final vapor temp. . . . 530°F.
Final liquid temp. . . . 660°F.

DISTILLATION SUMMARY

Cuts at:				
I.B.P.–410°F.	745 cc	37.25%	charge and	37.25% crude
410°–530°	530 cc	26.50%	charge and	26.50% crude
530°F.—60%	No cut cc	No cut	charge and	No cut crude
Lub. stock	720 cc	36.00%	charge and	36.00% crude
Water	0 cc	0%	charge and	0% crude
Loss	5 cc	5%	charge and	.25% crude
TOTAL	2,000 cc—	100.00%	charge and	100.00% crude

ENGLER DISTILLATION

Untreated Gasoline		*Untreated Light Gas Oil*		*Heavy Gas Oil*	
Per cent of crude	37.25	Per cent of crude	26.50	Per cent of crude	No cut
A.P.I. gravity	54.3	A.P.I. gravity	40.5	A.P.I. gravity	—
Octane No.	—	Flash	200°F.	Flash	—
		Fire	220°F.	Fire	—
I.B.P.	120°F.	I.B.P.	398°F	I.B.P.	—
5%	178°F.	5%	436°F.	5%	—
10%	208°F.	10%	440°F.	10%	—
20%	210°F.	20%	442°F.	20%	—
30%	230°F.	30%	444°F.	30%	—
40%	250°F.	40%	456°F.	40%	—
50%	262°F.	50%	462°F.	50%	—
60%	288°F.	60%	470°F.	60%	—
70%	310°F.	70%	478°F.	70%	—
80%	330°F.	80%	488°F.	80%	—
90%	358°F.	90%	504°F.	90%	—
95%	386°F.	95%	516°F.	95%	—
END POINT	408°F.	END POINT	531°F.	END POINT	—
RECOVERY	99%	RECOVERY	99%	RECOVERY	—

Lubricating Stock

A.P.I. gravity	30.0
Say. vis. at 100°F.	143 Sec.
Say. vis. at 210°F.	44 Sec.
Flash	310°F.
Fire	335°F.
Pour	62°F.
Per cent of crude	36.00

BULLETIN OF THE AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS
VOL. 20, NO. 5 (MAY, 1936), PP. 612-620

RESEARCH NOTES

ASSOCIATION RESEARCH COMMITTEE

(Members' terms expire immediately after annual Association meetings of the years shown)

D. C. BARTON (1936), *chairman*, Humble Building, Houston, Texas
H. W. HOOTS (1936), *vice-chairman*, Union Oil Building, Los Angeles, California
M. G. CHENEY (1937), *vice-chairman*, Coleman, Texas

R. S. KNAPPEN (1936)	F. H. LAHEE (1937)	STANLEY C. HEROLD (1938)
W. C. SPOONER (1936)	H. A. LEY (1937)	THEODORE A. LINK (1938)
PARKER D. TRASK (1936)	R. C. MOORE (1937)	C. V. MILLIKAN (1938)
ROBERT H. DOTT (1937)	F. B. PLUMMER (1937)	JOHN L. RICH (1938)
K. C. HEALD (1937)	JOHN G. BARTRAM (1938)	C. W. TOMLINSON (1938)
	C. E. DOBBIN (1938)	

The purpose of the research committee is the advancement of research within the field of petroleum geology. If members working actively in research on particular problems care to register with the research committee, the committee will be glad to aid them in any way it can and put them in touch with other men who are, or have been, working on similar or allied problems and can perhaps effect some integration of the research work of the Association. If the younger, or older, members of the Association, who are doing or preparing research for publication, will come to any member of the committee, he will be very glad to offer whatever advice, counsel, or criticism he can in regard to the research, its prosecution, or its preparation for formal presentation. The committee would be glad to have members formulate and present to it suggestions in regard to research problems and programs.

EXAMPLES OF MIGRATION OF PETROLEUM

PARTIAL DIGEST OF ROUND TABLE MEETING OF RESEARCH COMMITTEE, WICHITA, KANSAS, MARCH 20, 1935

"Examples of Reasonably Probable Migration" of petroleum formed the key subject before the annual meeting of the research committee at the Wichita meeting of the Association, March, 1935. The discussion at these round table meetings is informal and there is no obligation of submitting formally written reports on any material which is presented. At the request of the chairman of the research committee, the various speakers have submitted the following digests of their remarks at the Wichita meeting.

EDWARD BLOESCH: CLASSIFICATION OF VARIOUS FORMS OF OIL MIGRATION

The various types of the migration of oil may be classified according to the following scheme.

A. Source rock identical with reservoir rock
   1. Migration inside reservoir rock (lateral)
   2. No migration

B. Source rock not identical with reservoir rock
   1. Migration from source rock to reservoir rock
      a. Source rock directly adjacent to reservoir rock
      b. Source rock not adjacent to reservoir rock
         aa. Migration through intervening formations (vertical)
         bb. Migration along crevices, faults, etc. (vertical)
         cc. Migration along bedding planes and unconformities

2. Migration from one reservoir rock to another one
   a. Migration through intervening formations
   b. Migration along crevices, faults, etc.
   c. Migration along bedding planes and unconformities
3. Migration inside reservoir (lateral)

Certain of those forms of migration may have taken place only rarely. Type B1aa, for example, is conceivable as having taken place either before consolidation of the rocks, or under very unusual conditions of porosity. The often used terms of "lateral" and "vertical" migration can be applied properly only in the case of strata dipping at low angles.

J. C. BARTRAM: MIGRATION IN ROCKY MOUNTAIN DISTRICT

Most of the geologists in the Rocky Mountain states believe that oil does migrate. Many large anticlines of that area have appeared favorable for oil but have been dry where drilled. The difference between the occurrence of oil, gas, or water on the anticlines is difficult to attribute to source beds. A water-flushing theory has been developed to explain that difference and is favored by most Rocky Mountain geologists, and is opposed by few. It assumes that most of our favorable structures once were full of oil which has been removed from some by circulating water, probably drop by drop. Water enters the producing formations on the high outcrops along mountain ranges and leaves the same formations at lower points along the main streams.

In Wyoming the best producing structures may have oil or gas in from three to six different horizons, ranging in age from Upper Cretaceous to Mississippian, and a near-by, similar fold may have water in all the same beds. A good example is in the Lost Soldier or Separation Flat area of south-central Wyoming. The Lost Soldier field has oil in Frontier and Dakota sands (Upper Cretaceous), Sundance (Jurassic), and Tensleep (Pennsylvanian). The nearby Wertz anticline has gas in the Frontier, Dakota, and Sundance. (The Tensleep is untested.) Another anticline close to them, Bunker Hill, has water in the same beds. Bunker Hill has the least closure and is nearest the outcrops; Wertz, with gas, comes next in size and position; and Lost Soldier, with oil, is farthest away from the outcrop and is the largest structure. There are similar situations all over the Rocky Mountain area.

Another suggestion of migration is given by Salt Creek. A cross section through the field reveals the lower level of the oil pools in the First and Second Wall Creek sands approximately the same elevation above sea-level. This suggests that oil may have migrated through faults from one sand to the other until the oil-water level was the same.

HAROLD W. HOOTS: MIGRATION OF OIL IN CALIFORNIA

Los Angeles Basin.—A chart with a columnar section for each oil field in the Los Angeles Basin showing the position of all oil zones was exhibited to show available evidence as to the migration or non-migration of oil in this important district.

Most of the more important fields, Rosecrans, Dominguez, Long Beach, Seal Beach, Huntington Beach, Montebello, Santa Fe Springs, West Coyote, and East Coyote, have groups of oil zones, in a general way, in the same part of the Lower Pliocene and Miocene stratigraphic section. This rather uniform occurrence of producing zones suggests that this oil has not migrated upward from deeper horizons but has accumulated in the same general part of the

stratigraphic section from which it was derived. Much of it may have migrated a few hundred feet across bedding and as much as a few miles laterally.

Exceptions to the generally uniform stratigraphic occurrence of oil zones are not rare, however, particularly if close comparisons are made between positions of the uppermost oil zones and associated foraminiferal marker zones. The uppermost oil zone of Long Beach, for example, is stratigraphically 600 feet higher than that of Dominguez, Rosecrans, Torrance (?), and Playa del Rey; and about 1,200 feet higher than that of Seal Beach. These variations are possibly due in some measure to irregularities in the occurrence of sands and shales in this part of the section, and to the fact that the high-angle faults on the Long Beach anticline may have permitted migration of oil upward to higher beds.

The Inglewood field offers a more definite suggestion that upward migration has occurred along faults. The axial part of this prominent anticline is broken by two normal faults, at least one of which is known to have displaced upper oil zones about 600 feet. Apparently because of upward migration of oil along these faults, this field has its shallowest oil zone in the Pico formation (Upper Pliocene), 1,000 feet stratigraphically higher than the shallowest oil zones of other fields of the Los Angeles Basin.

The lower zone of the Playa del Rey field is the best example of minimum migration known in California. This lower zone rests directly on Franciscan schist (Jurassic?), having no possibilities as a source for oil, but is overlain by a 100–200-foot bed composed of the most highly bituminous shale found in oil-field sections of the United States (P. D. Trask, oral discussion at Wichita meeting). Evidence bearing on this shale as a source of Playa del Rey crude, and on the downward migration of the oil from the shale into the underlying conglomerate of the lower producing zone, has been presented by Hoots in a recent paper. It is reasonable to assume that the history of the lower zone oil is relatively simple, i.e., that it was forced from the underlying porous conglomerate and sandstone and later became concentrated up-dip in the axial part of the anticline. None of this oil need have migrated more than a few thousand feet.

Santa Clara Valley (Ventura County).—Several oil fields along the south side of the Santa Clara Valley in Ventura County offer definite examples of oil migration. These fields—South Mountain, Bardsdale, Shiells Canyon and Torrey Canyon—occur on individual anticlinal folds located along the east-west trending Oak Ridge uplift. In reality these separate folds constitute structurally high points on the major anticlinal uplift which is sharply asymmetrical with its steep and locally overturned north limb broken by a southward dipping thrust fault that passes beneath the uplift. The oil produced in these fields occurs in the middle two-thirds of a 7,000-foot section of the Sespe formation (Oligocene+), a stratigraphic unit entirely of continental origin and consisting of course gray and greenish sandstone conglomerate and red shale. Commercial oil could hardly have originated within these continental beds and must, therefore, have migrated into them either from organic marine Pliocene and Miocene beds beneath the thrust fault or from marine Eocene strata underlying the productive continental beds. The former appears to be the more reasonable.

San Joaquin Valley.—Little is known regarding the origin and migratory history of oil in the San Joaquin Valley fields, but there are several fields that

produce oil largely or entirely from continental deposits. Some areas, such as the Kern River field and Terra Bella, obtain all their production from the Kern River (Pliocene) formation which apparently was laid down as an old alluvial fan and obviously could not be considered as a likely source for oil. Most of the production at Kern Front and Fruitville, and oil of the uppermost zone (Hood) at Mountain View, comes from the lower part of the same Pliocene continental series. All of these fields are on the east side of the San Joaquin Valley near Bakersfield. Similar conditions exist on the west side of the valley north of McKittrick where oil in the Cymric district and on the east flank of Belridge is obtained from the basal part of the continental Tulare (Upper Pliocene) formation.

The lower part of the continental deposits yielding oil in the above mentioned areas is surmised to grade laterally and down dip into marine beds that occupy more central parts of the San Joaquin syncline, but definite proof of that gradation is lacking. One marine finger within this continental series extends up the east flank through the Fruitville field and as far as Kern Front. This gradation of inorganic continental deposits down dip into organic marine strata, if it exists to an important degree, offers a reasonable explanation for the occurrence of oil in these marginal continental beds. Another possible source for this oil lies in the marine Miocene strata of varying organic content, which underlie the continental Pliocene series at or near the present producing wells in all of these areas.

F. H. LAHEE: LATERAL MIGRATION OF OIL AT VAN, TEXAS

An interesting case of migration is presented by the Van field. There the Woodbine formation produces oil on a closed dome which is broken by a major fault, which trends northeast and southwest, with a minimum displacement of 500 feet. The downthrow is on the northwest side. The original water level was at −2,507 feet, completely surrounding the dome, on both upthrown and downthrown blocks. When the field was drilled free gas was found in the closure on the downthrown block, 300 feet lower than the closure on the upthrown block; and no free gas occurred in the latter. Holes drilled into water in the pay formation beyond the limits of the pool, and below −2,500 feet, encountered clean water sand on the upthrown side, but on the downthrown side revealed dead oil in the sand.

These facts suggest that oil and gas had accumulated in the Woodbine sand on the dome prior to faulting, and that, following the faulting, the gas remained in its original position on the crest of the dome, which had been dropped, and the oil on the downthrown side spilled across to the upthrown side until its lower edge, in contact with the water, became the same (−2,507 feet) on both sides. This seems to indicate rather easy lateral migration under a relatively small difference in pressures on the two sides.

C. V. MILLIKAN: RESERVOIR PRESSURE AS EVIDENCE FOR OR AGAINST VERTICAL MIGRATION OF OIL

Determinations of pressures in reservoirs should give definite information as to whether vertical migration is present in any particular area. The pressure data contained in my article "Geological Application of Bottom-Hole Pressures," in the Association *Bulletin*, Volume 16, Number 9, September, 1932, page 893, afford typical examples of such evidence. For example, on one

lease in the Seminole field, five producing horizons were found within vertical intervals of less than 300 feet, and the initial bottom-hole pressures determined in each of these horizons ranged from 637 to 1,520 pounds. The differences in pressure were ample to indicate that no vertical migration had occurred. A similar example occurs in the Hobbs, New Mexico, field. In the Fitts area, Pontotoc County, Oklahoma, upper gas sands are found which are reported to have pressures in excess of the hydrostatic head for the depth. These upper gas sands, however, have pressures much less than the original pressure in the Bromide sand which is the principal oil-producing formation. This field is located in an area of great structural disturbances and it would seem that, if vertical migration were to occur there, the large number of faults and fractures present in this field should make ready communication between the various reservoirs.

Although I do not desire to argue that vertical migration never occurs, I do feel that these examples are conclusive proof that vertical migration has not occurred in these areas and that it probably occurs only in a very few instances. I think we are too prone to accept a vertical migration theory merely as a simple way to explain a condition about which we do not have sufficient data to determine what the true condition is.

J. B. UMPLEBY: DOUGHERTY ASPHALT DEPOSITS; OIL-STAINED SANDS AT CENTER, OKLAHOMA; POSSIBLE IMPORTANCE OF MINOR FRACTURES IN MIGRATION

The general discussion this evening recalls two local situations that seem pertinent and one general observation from mining experience that may have some bearing on the problem.

1. In the vicinity of Dougherty, Oklahoma, there are three asphalt deposits well known to Oklahoma geologists. Some years ago I examined these for purposes of a bond issue and made detailed tonnage estimates. Two of the deposits are in upper sands of the Simpson formation and one is in the Viola limestone. The lime asphalt is on a closed structure nearly circular in outline, with dips ranging from 15° to 45°. It is traversed in a northwesterly direction by eight faults with small but measurable displacement. Several cross faults occur. Exposures in quarries show clearly that the bitumen content decreases outward from the fault fractures.

One of the sand deposits shows dips on the south, east and north, ranging from 10° to 40°. As regional dip is to the west, it is undoubtedly a closed structure, although that side is concealed by Frank's conglomerate. The other sand deposit is exposed in the channel of Rock Creek, bedding planes within the sand itself dipping east and west at angles ranging from 10° to 45°. It is probably also a sharp structure, although relations to the north and south are concealed by younger formations.

My interpretation of these situations is that we are dealing with three oil pools which by reason of sharp dips retained from 7 to 9 per cent of bitumen even after exposure by erosion. The oil in the Viola limestone apparently moved upward along faults and fractures soaking out laterally into less disturbed limestone.

2. In contrast to these fossil oil pools is the situation in the vicinity of Center, Oklahoma, at a point approximately 25 miles north of the asphalt deposits and somewhat farther out from the mountains. Here the Simpson

formation comes in around 2,000 feet below the surface and was penetrated for about 700 feet. Wells to the north, south, and west show a sharp dip in these directions. On the surface there is about 20 feet of east dip but there are no subsurface records to confirm it. A little heavy oil was found above a parting in the top of the first Simpson sand. The balance of the sand was stained with oil but contained a tremendous volume of sulphur water under artesian pressure. Three additional sands in the Simpson formation were oil stained and contained sulphur water which flowed from the casing. A few miles farther north and west wells yielded salt water from the same horizons. Off-structure wells in the general area yielded water from a clear white sand. My inference is that here we are dealing with an oil pool that was flushed out by meteoric water moving down the dip; its work facilitated by little or no closure toward the outcrop.

3. The general observation of which I spoke may or may not have a bearing on petroleum problems, but as faulting has been frequently alluded to in the discussion of oil migration, I would like to call attention to it. In mining experience it is generally true that ore deposits are related to minor fractures rather than to major faults. As a rule faults with easily measurable displacement are accompanied by gauge that seals them effectively even against the vaporous solutions causing mineralization. Applying this observation to oil accumulation, I am disposed to place little importance on the presence or absence of faults as shown by the correlation of well logs. It is quite possible that faults large enough to show up in our subsurface work are effectively sealed. On the other hand, where no faulting would be suspected from well-log studies, effective avenues for the vertical movement of solutions may well exist. Although assumptions in science are often dangerous, I think we are reasonably safe in assuming open fractures where other evidence points to vertical migration; and, on the other hand, in assuming that faults are sealed where we know them to exist but where other evidence indicated an absence of vertical migration. The reason for not applying these observations with full assurance is that faults vary widely in characteristics, apparently depending on the forces that caused them. An extreme case is in the Coeur d'Alene district of Idaho where the reverse faults very definitely have less gauge than the normal faults, a fact at variance with common ideas of thrust and tension.

In closing may I subscribe to Mr. Wegemann's thought that we have migration or we would not have the anticlinal theory. Fluid migration is proven by artesian circulation, by dehydration incident to the metamorphism of sediments, by cementation and various other well recognized phenomena. Personally, I am willing to accept any amount of migration necessary to explain a situation and believe that a heavy burden of proof rests on those who seek to explain even a local occurrence otherwise. I can only believe that wide migration of fluids is normal, lack of it exceptional.

ROBERT M. WHITESIDE: MIGRATION IN LUCIEN OIL FIELD DURING ORDOVICIAN

The presence of bituminous sandstone containing grahamite at the disconformity in the Ordovician sediments in the Lucien oil field, Oklahoma, is evidence of the exposure and oxidation of oil in the oil-bearing beds. That disconformity occurs with, and very uniformly at a depth of approximately 40 feet below the top of, the first Ordovician sandstone. On account of the

truncation at the top of the Ordovician sediments, the depth of the disconformity below the top of the Ordovician beds ranges from 115 to 193 feet.

Stanolind-Amerada, Boley No. 1, center of SW. ¼, NW. ¼, Sec. 16, T. 20 N., R. 2 W.—The disconformity was found between the depths of 5,258 and 5,262 feet, where the sand was black with grahamite.

Stanolind-Amerada, Kolb No. 1, center of NE. ¼, NW. ¼, Sec. 33, T. 20 N., R. 2 W.—The same disconformity was found in a core from 5,018 to 5,020 feet and also carried grahamite.

Minnehoma, Schonwald No. 2, center of SE. ¼, SE. ¼, Sec. 20, T. 20 N., R. 2 W.—The disconformity was cut between the depths of 5,168 and 5,174 feet and at it sufficient live oil was found to fill the hole 1,000 feet.

Lucien Consolidated, Schonwald No. 2, center of SW. ¼, NE. ¼, Sec. 20, T. 20 N., R. 2 W.—An initial production of 320 barrels an hour was obtained from the unconformity, at a depth of 5,140–5,150 feet.

Shell Petroleum Corporation, S.S. Tate 1A, center of NW. ¼, Sec. 29, T. 20 N., R. 2 W.—The disconformity was encountered between the depths of 5,188 and 5,112 feet. Gas at the disconformity had sufficient force to heave large chunks of black bituminous sandstone into the hole to fill the lower 400–500 feet of the hole. Residual bitumen or grahamite was found at the disconformity in most of the wells. Live oil was encountered in bituminous sandstone at the disconformity in several wells.

W. B. WILSON: EVIDENCE OF OIL AND GAS MIGRATION—CRESCENT POOL

The Crescent pool is located in the south-central part of T. 17 N., R. 4 W., Logan County, Oklahoma. It is not yet fully developed, but probably will prove to be about 1 mile wide by 2½ miles long. More than 400 feet of structural closure is indicated with the long axis of the structure extending nearly north and south.

Near its crest the structure is cut by a north-south fault downthrown toward the west approximately 300 feet. Apparently this fault divides the structure into two separate reservoirs, since in the "Wilcox" sand gas and oil are found at a sub-sea elevation lower than the water level established in the same sand east of the fault.

It is the writer's belief that evidence supports a theory that a reservoir of oil possibly with a gas cap was developed at Crescent at a time not later than the close of the Mississippian. In the development of the structure the upthrust eventually became so intense that a fault developed, displacement along which was practically completed by Oswego time. Up to the time of the faulting the oil and gas content should have been essentially uniform throughout the reservoir. Prior to the faulting there was something less than 1,000 feet of over-burden on the reservoir, and a gas cap was likely present in it. Samples taken by bottom hole bombs show that the gas cap would have disappeared by the time the overburden developed and pressure of 2,500–2,600 pounds occurred. The weight of 6,500 feet of overburden now on the reservoir is sufficient to hold the gas in solution in that part of it lying east of the fault. In that part of the reservoir west of the fault, a gas cap is present although the pressure on the reservoir is somewhat higher.

A reasonable inference from these data is that subsequent to the faulting gas has been added to the west reservoir sufficient to develop a gas cap in it. It seems that some heavy oil has been added to it, since the gravity of the oil in that reservoir is approximately 2° lower and the oil is of a noticeably darker color.

For those who are not familiar with the area, it may be added that regional dip in the vicinity of Crescent is west or southwest, and therefore, the west reservoir is open to territory from which migration might be expected, whereas the reservoir east of the fault is cut off by the fault to the west and by a syncline a short distance to the east.

D. C. BARTON: MIGRATION OF OIL AT SPINDLETOP

Five and possibly six types of oil are present. The types, V, B, C, and D, are found successively above the succeeding type, but no one of them is migrant oil of either the other types. Type A in the cap rock is surmised to be migrant oil of the surmised type V. Local minor migration of a stratigraphically lower type into the zone of a stratigraphically higher type has taken place.

Cf.—"Variation and Migration of Crude Oil at Spindletop, Jefferson County, Texas," *Bull. Amer. Assoc. Petrol. Geol.*, Vol. 19, No. 5 (May, 1935), pp. 618-43.

D. C. BARTON: MIGRATION OF OIL AT BELLE ISLE, ST. MARY PARISH, LOUISIANA

Showings of oil have been found at Belle Isle only on the salt spine in the north tenth of the dome. The showings are found (a) at the contact of the salt and the overlying sediments and (b) in salt. The Knapp No. 1 had showings of oil in the salt practically all the way from the top of the salt at 140 feet to the bottom of the hole at 3,171 feet, in the salt. Other shallower wells into the salt also had showings of oil. Several of these wells were still seeping oil a few years ago, more than 20 years after they were drilled. The oil is light and can be used in a kerosene lantern. Two old flank wells had poorer showings of oil. The more recent flank wells, the Union Sulphur Company's 3, 8, and 10, have no showings, although Nos. 3 and 8 were in and out of the edge of the cap. No showings at all were obtained by the many wells into the cap and to the top of the salt over the rest of the dome away from that northern salt spine. The oil seemingly must have migrated up within the salt mass from depths greater than the 4,000± feet to which the flank wells go.

References on Belle Isle.—"Belle Isle Salt Dome, St. Mary Parish, Louisiana," *Bull. Amer. Assoc. Petrol. Geol.*, Vol. 19, No. 5 (May, 1935), pp. 644-50.
F. E. Vaughan, "The Five Islands, Louisiana," *Geology of Salt Dome Oil Fields* (Amer. Assoc. Petrol. Geol., 1926), pp. 382-92.

R. W. BRAUCHLI: MIGRATION OF OIL IN OKLAHOMA CITY FIELD

Published in *Bull. Amer. Assoc. Petrol. Geol.*, Vol. 19, No. 5 (May, 1935), pp. 699-701.

J. E. ADAMS: OIL POOL OF THE OPEN RESERVOIR TYPE

To be published in *Bull. Amer. Assoc. Petrol. Geol.*, Vol. 20, No. 6 (June, 1936).

DONALD C. BARTON, *chairman*

HOUSTON, TEXAS

RESEARCH IN PETROLEUM GEOLOGY

Professor F. B. Plummer of the University of Texas has submitted to the research committee a "Report of a Canvass of Research Work in the United States Pertaining to Some Phase of Petroleum Geology." Typewritten copies of a 13-page report may be obtained by request at the Association headquarters, Box 1852, Tulsa, Oklahoma. The following is quoted from Professor Plummer's letter of March 10, 1936.

About 1,000 questionnaires were sent out to research workers, universities, and state geological surveys. About 75 replies were received giving data on more than 100 projects now under way and suggesting a number of other projects for the consideration of the committee.

The projects may be classified into the following divisions.

Geophysics	5
Mineralogy	2
Paleontology	12
Petrography	2
Petroleum chemistry	4
Petroleum economics	3
Petroleum engineering	10
Petroleum geology	5
Subsurface geology	7
Physiography	7
Sedimentation	9
Stratigraphy	14
Structural geology	14
Underground water	5
Total	99

The list does not, by any means, include all the investigations that are being carried on. It does, however, indicate the types of investigations that are proving most interesting to the universities and state geological surveys. Many of the oil company research workers did not reply to the questions, and most companies do not find time for research. The report indicates, however, that a few companies are undertaking some really fundamental investigations.

F. B. Plummer

Austin, Texas
March 10, 1936

BULLETIN OF THE AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS
VOL. 20, NO. 5 (MAY, 1936), PP. 621-672, 3 FIGS.

THE ASSOCIATION ROUND TABLE

MEMBERSHIP APPLICATIONS APPROVED FOR PUBLICATION

The executive committee has approved for publication the names of the following candidates for membership in the Association. This does not constitute an election, but places the names before the membership at large. If any member has information bearing on the qualifications of these nominees, he should send it promptly to the executive committee, Box 1852, Tulsa, Oklahoma. (Names of sponsors are placed beneath the name of each nominee.)

FOR ACTIVE MEMBERSHIP

Robert Arthur Carmody, Wichita, Kan.
Anthony Folger, R. S. Knappen, W. B. Wilson
Stanley Gordon Elder, Urbana, Ill.
Charles H. Behre, Jr., Alfred H. Bell, Harry X. Bay
Merrill Evans Lake, Oklahoma City, Okla.
G. H. Laughbaum, Frederic A. Bush, Fanny Carter Edson
John Francis Mahoney, Sulphur Mines, La.
J. M. Vetter, Marcus A. Hanna, Henry C. Cortes
Frank Charles Roper, LaFayette, La.
R. J. St. Germain, S. D. Butcher, Karl E. Young

FOR ASSOCIATE MEMBERSHIP

Fred Westerman Bates, San Antonio, Tex.
John R. Sandidge, Adolph Dover, Worth W. McDonald
Eugene M. Baysinger, Urbana, Ill.
Morris M. Leighton, Alfred H. Bell, Harry X. Bay
Douglas E. Bell, Houston, Tex.
L. T. Barrow, L. P. Teas, F. W. Rolshausen
William Richard Canada, Lake Charles, La.
R. B. Grigsby, Alan M. Bateman, L. C. Roberts, Jr.
Howard Franklin Colton, Okmulgee, Okla.
Robert M. Whiteside, Louis Roark, David M. Logan
Richard Merrill Harris, Sulphur, La.
Frank C. Adams, Charles E. Decker, J. M. Vetter
Iliff S. Higginbotham, Tulsa, Okla.
W. J. Allen, W. C. Adams, Richard Hughes
Laurence F. Lees, Tyler, Tex.
A. C. Trowbridge, Jack M. Copass, Donald M. Reese
Ed Dickinson Wappler, Shreveport, La.
E. A. Stiller, W. C. Spooner, D. H. Bingham
Hal Wynne, Pauls Valley, Okla.
Stuart Sherar, S. Zimerman, V. E. Monnett

TRANSFER TO ACTIVE MEMBERSHIP

W. M. Angle, Houston, Tex.
A. R. Denison, Jess Vernon, John L. Ferguson

Paul K. Goodrich, Dallas, Tex.
F. H. Lahee, R. E. Rettger, F. E. Heath
Alexander E. McKay, Bartlesville, Okla.
R. J. Riggs, G. H. Westby, Homer H. Charles
J. Lawrence Muir, Enid, Okla.
Charles E. Decker, Dollie Radler Hall, Robert L. Cassingham
Paul F. Osborne, Midland, Tex.
Prentice F. Brown, E. Russell Lloyd, Fred H. Wilcox
Elwood C. Sargent, Austin, Tex.
F. B. Plummer, E. H. Sellards, G. E. Green
Dana M. Secor, Pampa, Tex.
James FitzGerald, Jr., Gerald C. Maddox, Lewis W. MacNaughton
Daniel Charles Shay, Shreveport, La.
Rual B. Swiger, Stanley E. Jay, J. F. Hosterman
Stephen Gose Waggoner, Wichita Falls, Tex.
Tom L. Coleman, R. A. Birk, Virgil Pettigrew
Oscar Edward Walton, Shreveport, La.
Alfred Gray, Sam Aronson, E. D. Luman

TWENTY-FIRST ANNUAL MEETING
THE AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS
MAYO HOTEL, TULSA, OKLAHOMA, MARCH 19–21, 1936

Reporters of previous conventions have practically exhausted the supply of superlatives in our language, so that it is difficult adequately to describe the twenty-first annual meeting held in Tulsa, March 19–21. We are therefore reduced to the expedient of a simple expression of gratitude and admiration to our Tulsa hosts and hostesses for one of the most delightful conventions yet held. Tulsa in every way lived up to and even exceeded its well earned reputation as a premier convention city.

The Mayo looked the same as at the twelfth annual meeting in 1927, and at the joint meeting with the Geological Society of America in December, 1931: the milling crowd in the flag-draped lobby, the registration desk on the south mezzanine, the exhibitors' booths in the small banquet rooms along the south side of the sixteenth floor, the Crystal ball room, equipped for the main meetings, another milling crowd in the foyer, and the jam in front of the elevators.

A large delegation had arrived by Wednesday night. More than 100 attended the research committee dinner and meeting. Members of the executive committee were in almost continuous session, beginning Tuesday night transacting their quota of the voluminous business of the Association. Other committees contributed their energies to make the wheels of the Association, the Division of Paleontology and Mineralogy, and the Division of Geophysics go 'round.

Mrs. A. I. Levorsen opened her home to visiting ladies on Wednesday night, and Tulsa hostesses had arranged for the traditional tea and luncheon on Thursday and Friday, at Oakhurst Country Club and the Tulsa Country Club, respectively, with a sight-seeing tour of Tulsa on Thursday morning. Thursday night a co-ed smoker was given on the sixteenth floor of the Mayo,

Photograph by Rirkin Studio

Banquet scene, twenty-first annual meeting, Crystal ball room, Mayo Hotel, Tulsa. Five hundred more than those shown here were dining in the Junior ball room of the Mayo and at the University Club across the street.

with a popular lecture by Barnum Brown of the American Museum of Natural History, on "The New Dinosaur Kingdom," followed by smokes, coffee, and doughnuts. The Friday night dinner-dance was held in the Crystal ball room of the Mayo and the ball room of the University Club across the street, and a large overflow was fed in the Junior ball room of the Mayo and the Mayo mezzanine.

The numerous committees of the Tulsa Geological Society and their wives had been at work for weeks in preparation for handling the convention, and their well laid plans and efficient execution bore fruit in one of the smoothest-running conventions in Association history. To superficial appearances, the convention just ran itself.

Of all the unsung heroes, the members of the program committee are entitled to resounding cheers. Their work must start long before convention time, in order to get a list of suitable papers. Then just before the meeting, arrangements must be made for rooms, loud-speaker equipment, lanterns, black boards, et cetera. But the big job comes while the meetings are going on. Pointers, chalk, thumb tacks, lantern operators, spot lights, and numerous other small items which go to make the program successful, must be at hand exactly when wanted. They must be put away at night and ready again the next morning. Bulletin boards in half a dozen places must be posted frequently, so that members of the Association may know what talks are in progress in all sessions, at all times. With papers being given on the sixteenth floor, on the mezzanine, across the street, and also at the Tulsa Hotel, this means lots of work.

Following the last paper Saturday afternoon, about 60 geologists left in a bus for the field trip in the Arbuckle Mountains arranged by a committee headed by N. W. Bass. The bus followed U. S. Highway 66 to Bristow, thence south through Ada, on Oklahoma Highway 48, arriving in Sulphur at 9:00 P.M. The trippers beguiled the time en route by following a road log prepared by Darsie Green.

After a late dinner in Sulphur, talks were given by C. E. Decker and C. W. Tomlinson on the following day's trip and on some structural problems in the Arbuckle Mountains. Sunday morning was spent in inspecting the lower Paleozoic exposures along U. S. Highway 77, on the south side of the Arbuckle anticline, under the able guidance of C. E. Decker. The party then returned to Sulphur, and arrived in Ada at noon for lunch.

At 1:00 P.M., the party, augmented by other geologists and citizens of Ada, assembled at the entrance to the East Central State Teachers College, to witness and participate in the unveiling of the David White memorial. This memorial is the base of a large tree belonging to the genus *Callixylon*, found by John Fitts in an exposure of Woodford chert southeast of Ada, and later inspected and identified by David White. It was moved to its present location by John Fitts, erected under the supervision of Churchill Thomas of Ada, and dedicated, with a bronze memorial plaque, to the memory of David White.

The program was in charge of Dean C. E. Wilson, of East Central State Teachers College, and consisted of four addresses: by Hugh D. Miser, chief of the fuel section of the U. S. Geological Survey; G. F. Loughlin, chief geologist of the U. S. Geological Survey, who read a paper by E. W. Berry on the geology of *Callixylon*, and presented the memorial; Miss Taisia Stadnichenko, former assistant to David White; and A. Linscheid, president of East Central State Teachers College, who accepted the memorial. Dean

Wilson also introduced John Fitts as donor of the memorial. The four addresses are in their entirety on the following pages.

In addition to the speakers, the following geologists were seated on the platform: E. O. Ulrich, Miss Olive C. Postley, Miss Agnes M. Farrell, of the U. S. Geological Survey; C. E. Decker, University of Oklahoma; Frank R. Clark, Tulsa; C. W. Tomlinson, Ardmore; and Robert H. Dott, Oklahoma Geological Survey.

This occasion sets a new landmark in the study of Oklahoma geology and is doubly significant. First, it was a fitting tribute to a scientist of world-wide renown, who contributed his efforts to the study of certain phases of Oklahoma problems. Second, this monument constitutes perhaps the largest speciman of the largest known Devonian tree. In dedicating it to a great scientist, attention should be called to the fact that it comes from one of the formations of a remarkable Paleozoic section, units of which are wonderfully exposed in south-central Oklahoma.

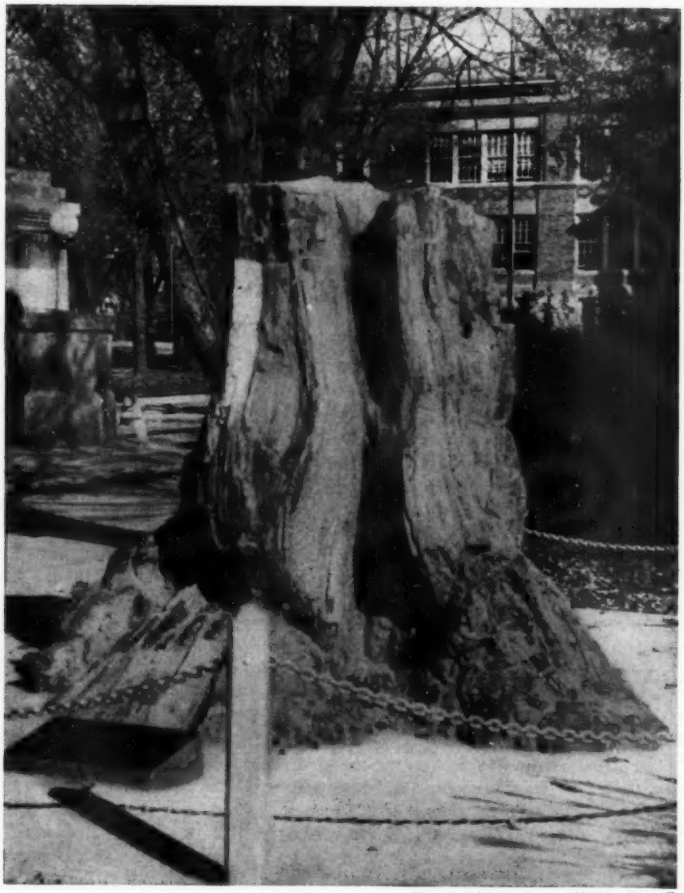
Following the unveiling of the memorial, the party was taken through the Fitts field, under the guidance of Don L. Hyatt, and disbanded at 4:00 P.M., after inspecting the Viola and Simpson sections so well exposed on Murray Lane, 3 miles south and within sight of the Fitts field.

ROBERT H. DOTT

DAVID WHITE[1]

Six years ago Dr. David White, whose memory we are here assembled to honor, came to Oklahoma and rendered service in the solution of important geologic problems that are presented by the petroleum and coal deposits of the state. During this visit to the state, the last of his many visits to the Mid-Continent region, he came to Ada and spent one day under the guidance of John Fitts for the purpose of studying important exposures of rock strata. The field party on that day also included Professor Churchill Thomas and the speaker. Late in the afternoon of that day Doctor White climbed over a high plank fence surrounding a portion of the Seven Cross Ranch of H. R. Brown, 20 miles southeast of Ada, and from the fence he obtained his first glimpse of a near-by giant petrified log lying prone on the surface of the ground. His enthusiasm and interest were unbounded during his examination of the log, with its excellent state of preservation, its size ($4\frac{1}{2}$ feet in diameter), and its great age (about 300 million years). He identified the log as belonging to the genus, *Callixylon*, and pronounced its discovery as revealing the largest known tree of so great an age. He earnestly suggested the preservation of the tree for posterity. This suggestion, however, did not become a reality before his death on February 7, 1935. To-day we fittingly honor his memory by the unveiling of the giant *Callixylon* tree whose preservation as a permanent memorial to Doctor White has been sponsored and accomplished by the benevolent and appreciative spirit of John Fitts, with the cordial cooperation of Doctor Linscheid, Professor Thomas, and other officials of the East Central State Teachers College. Furthermore, the preservation of the tree in Oklahoma and its dedication to Doctor White are appropriate because he was deeply interested in the geology of Oklahoma, one of the leading oil-producing states of the United States, and also because one of his fields of research was the study of the ancient plant life. In this field he gained recognition as a world-wide authority.

[1] A ten-minute talk by Hugh D. Miser, chief, Fuel Section, U. S. Geological Survey, at unveiling of David White Memorial, Ada, Oklahoma, March 22, 1936.



Photograph by courtesy of "Tulsa World"

Callixylon, Devonian tree, found in the Woodford chert by John Fitts and dedicated to the memory of David White. This monument stands on the campus of East Central Oklahoma State Teachers College, at Ada.

His interests in geologic studies were, however, broad and he devoted much time to many fields outside that of the study of fossil plant life. He had much to do with the growth and expansion of the petroleum industry in the United States, including especially Oklahoma, and the influence of his ideas has encircled the earth. He gained the distinction of being the leading American authority on the origin and evolution of coal.

David White was born of early pre-Revolutionary stock, July 1, 1862, on a farm in Wayne County, New York. His education was obtained in country schools, in the Collegiate Institute of Marion, 1 mile north of his home, and in Cornell University. He financed his way through college by borrowing money, by obtaining a State scholarship, and by the teaching of elementary freehand drawing. Botanical training received at both Marion and Ithaca directed his main interest to fossil plants, and after he became a member of the United States Geological Survey in 1886 he was from time to time assigned increasing responsibilities in his paleobotanic work. He was still a member of that organization at the time of his death. His entire scientific career of almost 49 years was therefore linked with the Geological Survey.

David White and Mary Elizabeth Houghton, of Worcester, Massachusetts, were married February 2, 1888, and he considered their life-long spiritual and intellectual companionship the greatest good fortune of his life.

Doctor White's tact, ability, and record of achievements led to his appointment to administrative positions of great responsibility on the Geological Survey. His enthusiastic leadership as Chief Geologist of that organization for the ten-year period November 16, 1912, to November 16, 1922, established an outstanding record of service to the Nation and of progress in the science of geology, including petroleum geology. In this position his wise judgment and broad interests shaped the economic and scientific investigations of the Geological Survey. This was especially true of the World War period, when he was a constant source of encouragement and inspiration to his assistants, and tirelessly devoted patriotic service—time, energy, and thought—to the interests of the Nation.

The active participation of Doctor White in problems relating to petroleum was maintained during his term as chairman of the Division of Geology and Geography of the National Research Council for the three years, 1924–27. In this position he was the leader in the formulation and prosecution of a program of research in petroleum that was undertaken by the American Petroleum Institute. This large program, financed by half a million dollars over a 5-year period, was wide in its scope and included projects pertaining to the origin, recovery, composition, and properties of petroleum.

Because of his distinguished services in the field of petroleum geology, he was elected to honorary life membership in the American Association of Petroleum Geologists; in 1931 he was awarded the Penrose medal by the Society of Economic Geologists; and in 1934 he received the Boverton Redwood medal from the Institution of Petroleum Technologists of London. In recognition of his services in the field of paleobotany he received from the National Academy of Sciences the Mary Clark Thompson medal and the Walcott medal, and he was elected to honorary membership in the Geological Societies of Belgium and China. He received honorary degrees from the Universities of Cincinnati and Rochester, and from Williams College.

He was a member of numerous scientific societies and was elected to important offices of many of them, including the National Academy of Sciences, the Geological Society of America, the Geological Society of Washington, and the Washington Academy of Sciences.

Many honors thus came to him as a fitting reward for the full measure of industry, accomplishments, and helpfulness that he crowded into his life. These honors, which were bestowed during his life time, and the memorial, which is today dedicated to Doctor White, do not signify merely a recognition of an able geologist but of a truly great man as well, in whom simplicity and humanness—basic elements of greatness—were enshrined. His life was characterized by a singular sweetness of disposition, great unselfishness, a love of nature, an appreciation of beauty, a capacity for ready wit, and a reverence for honor.

Mr. Fitts, Doctor Linscheid, Professor Thomas: Your spirit in planning for this occasion and your material expression of this spirit by the erection of the memorial which we now behold constitute a most noble and outstanding appreciation of the service of Doctor White to his fellowmen.

HUGH D. MISER

GEOLOGY OF CALLIXYLON[1]

As a lifelong friend and admirer of David White I greatly appreciate the opportunity of taking even so slight a part in this memorial meeting and sincerely regret my inability to be present. Mr. Fitts and the other members of the committee have had the good fortune to have thought of a monument, which I know would have pleased our friend more than any other that could have been suggested, and one for which all of his innumerable friends will always feel deeply grateful.

It is a long, long time after the appearance of the abundant and fairly advanced marine faunas of the Cambrian before any recognizable traces of land plants are found in the geological record. Opinions differ widely as to whether this difference in time is a real measure of how long it took to clothe the land with its first green mantle, or whether future discoveries will alter our concepts. Having in mind that the character of Lower Cambrian marine life involves a very long antecedent even if unknown period of evolution, it is reasonable to suppose that the invasion of the land by marine plants and the adaptations by which they protected their spores and subsequently their seeds from dessication, the means by which they conserved their water from evaporation, the ways in which they developed mechanical tissues that enabled them to carry their foliage up from the ground demanded time—quite as much time or even more than was required to change a fish into a reptile—and we get something of an idea of what an incomprehensible time was required to produce a tree with the structure of the specimen in front of us.

Callixylon is the name of a genus of trees, proposed by a Russian paleobotanist a few years ago, to denote a particular kind of petrified wood, long known from both North America and Europe under the name of *Dadoxylon*.

The latter is the wood of trees with *Cordaites* foliage and fructifications and in general slightly later in time, and reaching its greatest development in the post-Devonian Paleozoic.

[1] By E. W. Berry, Johns Hopkins University, Baltimore, Maryland. Read by G. F. Loughlin, chief geologist, U. S. Geological Survey, at unveiling of David White Memorial, Ada, Oklahoma, March 22, 1936.

Callixylon differs from *Dadoxylon* in certain anatomical details which are probably of no very great systematic importance. The chief difference is that in the walls of the conducting elements of the wood, the tiny communicating pores between adjacent tracheids, as these elements are called, are alternating in multiple rows in *Dadoxylon*, and are massed in groups with smooth walls between the successive groups in *Callixylon*.

Nothing is certainly known of either the foliage, fruits, or seeds of *Callixylon* and this is probably due to the fact that it grew in areas remote from basins of sedimentation, and only fragments of its windfall branches and trunks, or undercut trees on the margin of some Devonian stream reached the sea.

Among the many points of interest which *Callixylon* has for us are its very great age, and more particularly its large size—it being much the largest known Devonian tree.

The magnificent specimen before us will give you some idea of this, and of what its height in life may have been, since in its habit of growth as well as in its minute woody structure it was essentially like a living pine or redwood.

These considerations of structure and relationship lead to the conclusion that the individual of which this monument is a fragment may well have lifted its crown one hundred or more feet above the ground.

The differences between *Callixyon* and modern coniferous types, such as the pine, with which I have compared it, is that this ancient Devonian tree had a conspicuous pith at the center of its trunk and that the minute communicating pits in the walls of its conducting tissue, already alluded to in comparisons made with *Dadoxylon* were in groups, whereas in a modern pine they are in unilinear rows. There are other and technical histological details that need not concern us.

In many of these features in which *Callixylon* differed from a modern pine or cypress, it was much more like another living conifer known as *Araucaria*, very young specimens of which may be known to some of you as potted plants under the name Chilean or Norfolk Island pines.

Araucaria might be called another one of those living fossils like the ginkgo tree or the *Lingula*, for today it is native of isolated areas in the Antipodes: in the Chilean Andes, in Paraná, and on the other side of the world in the Australian region. Its ancestors constitute a noble line, highly characteristic of Mesozoic forests and very nearly cosmopolitan in range throughout the Age of Dinosaurs.

The amazing feature about *Callixylon* is that so highly organized a type should have existed at so remote a period as that of Woodford chert. Without giving the details of this organization I think I can make this point conclusive by citing its habit of forming a cylinder of secondary wood by annular seasonal layers almost exactly as in a modern conifer. This was an accomplishment that surely implies some millions of years of antecedent evolution.

Callixylon is the earliest known type that had reached this goal and after all of the eons from then until now this method of increase in girth which also implies increase in height and the ability to carry an ever increasing amount of foliage—that is, an ever increasing area of photosynthetic surface—has not been surpassed.

Callixylon in the form of drift logs is fairly abundant in both the Middle and Upper Devonian of both the old and the new worlds and appears not to

have died out until Mississippian times. It has recently been shown by Arnold that the carbonized branches which are not uncommon in the black shale lenses and tongues in western New York, Ohio and elsewhere, which have long been known, and which have masqueraded under a variety of names, also belong to *Callixylon*.

Most elements of Devonian floras as we know them are clearly marsh plants of inconsiderable size and simple structure. Many paleobotanists have considered them as primitive and ancestral as well as simple, but the contemplation of *Callixylon*, its great size and complex structure not only tends to render this view untenable, but holds out the hope that since all we have thus far found are drifted branches and trunks *Callixylon* was a dry ground or perhaps an upland type, and that some day we may discover its foliage and fruiting characters along with other and still unknown associates of *Callixylon* in this non-marshland habit.

The petrified trees in the Mokattam hills east of Cairo in Egypt have been known to travelers for centuries and have been famous in scientific circles for several generations. Our National Government has set aside as monuments the petrified trees of Arizona and the great cycad locality in the Black Hills rim. Another such are the fossil forests in the Yellowstone National Park, but the monument which the petroleum geologists have this day dedicated on the campus of East Central State Teachers College like the giant granite erratic on a peak in the Austrian Alps which the geologists of Europe dedicated to the memory of another of Nature's noblemen, Leopold von Buck, will long remain as a tribute to a life that had an equally wide influence in his day and generation, and which will be remembered as long as men retain an interest in the land which they inhabit, and the autobiography of the earth on which they live.

EDWARD W. BERRY

MEMORIAL TO DAVID WHITE

Mr. Chairman, ladies and gentlemen, and all friends of "Uncle David":

Mrs. White in asking me to come here wished to convey her deep gratitude and appreciation to Mr. Fitts and President Linscheid for the memorial to Doctor White. She is, like her husband, a person who shuns the light of publicity, but she was very happy to know that such a memorial is being dedicated to Doctor White as a true monument to him who so lovingly devoted all his life to science.

Everyone who knew Doctor White even slightly remembers his enthusiasm for his work and his keen interest in every aspect of it. I think we all would have loved to be present with Mr. Miser and Mr. Thomas when Mr. Fitts showed to Doctor White and them this truly unique tree. We can well imagine how overjoyed was Doctor White at viewing this specimen—about three hundred million years old, as Mr. Miser told you—and so beautifully preserved.

Doctor White, in addition to his high qualities mentioned before, was an idealist and a great patiot. He always loved young people, especially in late years as he realized that the future destiny of his beloved country depended on the quality of their ideals and the strength of their characters. It is therefore most appropriate to have this memorial located on the campus grounds. I believe that Doctor White would appreciate the participation of

Photograph by Ward Photo Company

Association executive committees at twenty-first annual meeting, Tulsa, Oklahoma, March 21. Standing, left to right: L. C. Snider, editor (re-elected); A. I. Levorsen, president, 1935–36; E. C. Moncrief, secretary-treasurer, 1935–36; W. B. Heroy, past-president. Seated, left to right: C. E. Dobbin, vice-president; R. D. Reed, president; Chas. H. Row, secretary-treasurer.

students in this ceremony, and I hope that they, in some way, in passing by this memorial and seeing the remains of this magnificent tree, will catch the spirit of idealism and patriotism of him to whom it is dedicated.

TAISIA STADNICHENKO

ACCEPTANCE OF DAVID WHITE MEMORIAL[1]

It is a keen and positive pleasure to accept this monument, discovered and donated by John Fitts, and dedicated this day to a great American, David White, whose contributions to the science of geology are known on both sides of the Atlantic. In Europe and in America where learning and research are held in esteem the name of David White is known and honored among men.

To-day we are dedicating this *Callixylon* which grew eons ago to one who did so much to give us a better understanding of the long ago, and thus increased our knowledge of this earth on which we live and move and have our being. It is altogether fitting and proper that we should do this, for no one deserved honors more than David White; but in a very real sense we cannot increase his honor, his solid achievements in the field of science have already placed him far beyond our poor power to add or detract. To-day we have only cheers and tears for David White—cheers for his achievements, tears for his death.

On behalf of the East Central State Teachers College, acting as its representative and speaking for its Board of Regents, I accept this monument dedicated to David White. In doing so, I express the thanks of the Institution, its faculty, students and friends, to the donor and to all who have appeared on the program with the assurance that henceforward this monument will be forever sacred to the memory of David White, and the spot on which it stands on this campus will be forever hallowed ground.

A. LINSCHEID

NEW OFFICERS

Officers elected at the annual meeting, for the term of one year ending in March, 1937, are: president, Ralph D. Reed, Los Angeles, California; vice-president, Carroll E. Dobbin, Denver, Colorado; secretary-treasurer, Charles H. Row, San Antonio, Texas; editor, L. C. Snider (re-elected), New York City.

The Division of Paleontology and Mineralogy elected: president, Merle C. Israelsky, Houston, Texas; vice-president, R. W. Harris, Norman, Oklahoma; secretary-treasurer, Gayle Scott (re-elected), Fort Worth, Texas; editor, Raymond C. Moore (re-elected), Lawrence, Kansas.

The Division of Geophysics elected: president, Ludwig W. Blau, Houston, Texas; vice-president, Gerald H. Westby, Tulsa, Oklahoma; secretary-treasurer, John H. Wilson, Denver, Colorado; editor, F. M. Kannenstine (re-elected), Houston, Texas.

GOLF TOURNAMENT

The annual golf tournament for the J. Wallace Bostick cup was held Friday afternoon, March 20th, at the Tulsa Country Club. The tournament consisted of eighteen holes medal play for the cup and trophy, and in addition a number of commercial prizes were offered in a blind bogey. Thirty-

[1] By A. Linscheid, president, East Central State Teachers College, Ada, Oklahoma.

eight members and nine invited guests participated, a total of forty-seven. The winner of the J. Wallace Bostick cup was R. A. Waxler (visitor), oil operator of Tulsa, with a score of 76. Two members, E. B. Hopkins and Dean M. Stacy of Dallas and Oklahoma City, respectively, turned in medal scores of 85 and have their names engraved on the trophy as co-member winners. The following were winners of prizes.

Runner up (visitor)	Sidney Davis	Hand bag
Runner up (member)	E. R. Brockway	Hand bag
Blind Bogey		
1st Flight	George C. Gester	Sweater set
	George W. Snider	1 doz. golf balls
2nd Flight	E. B. Hopkins	Pencil
	R. D. Jones	Comb and brush set
3rd Flight	A. M. Lloyd	Cocktail shaker
	L. G. Keppler	Hand lense
4th Flight	D. O. Chapell	Poker set
	Gerald Roberts	Flask
Best selected 9 holes		
1st Flight	Geo. W. Snider	½ doz. golf balls
2nd Flight	E. B. Hopkins	½ doz. golf balls
3rd Flight	Dean M. Stacy	½ doz. golf balls
4th Flight	R. A. Waxler	½ doz. golf balls
Eagles	E. A. Dawson	3 golf balls

Convention Registration

The total convention registration of 1,847 is classified as follows: 2 honorary members, 675 members, 114 associates, 536 non-member men, 520 non-member women. This is the largest registered attendance in the history of the Association to date.

Executive Committee

The executive committee of the Association during the administrative year ending with the twenty-first annual meeting, March, 1936, were: A. I Levorsen, chairman; E. C. Moncrief, secretary; W. B. Heroy, Frank A. Morgan and L. C. Snider.

Tulsa Geological Society

The officers of the Tulsa Geological Society, at whose invitation the meeting was held in Tulsa, are: president, R. B. Rutledge; first vice-president, G. S. Lambert; second vice-president, Lucian H. Walker; secretary-treasurer, Larry D. Simmons; editor, John S. Redfield.

Tulsa Committee

The local committees of the Tulsa Geological Society arranging the details of the convention were the following.

General.—Frank Rinker Clark, chairman; W. B. Wilson, in charge of arrangements; Ira H. Cram, in charge of technical program.

Technical Sessions.—J. L. Borden, chairman; Ed. Cahill, T. C. Newman, Charles Ryniker, Gerald H. Westby.

Registration.—Stanley B. White, chairman; Dollie Radler Hall, L. H. Lukert, J. D. McClure, J. S. Redfield.

Entertainment.—Larry D. Simmons, chairman; W. E. Bernard, C. G. Carlson, George V. Dunn, Wm. E. Horkey, Clark Millison, H. F. Sackett, G. C. Siverson.

Publicity.—R. T. Lyons, chairman; L. G. E. Bignell, M. H. Brown, J. B. Leiser, Floyd Swindell.

Trips.—N. W. Bass, chairman; Howard Clark, R. C. Coffin, Chas. E. Decker, John Fitts, C. W. Tomlinson.

Golf.—R. J. Cullen, chairman; Lewis G. Mosburg, Roscoe E. Shutt.

Reception.—R. B. Rutledge, chairman; A. L. Beekly, Ed. Bloesch, F. A. Bush, G. S. Lambert, L. Murray Neumann, Lucian H. Walker.

LADIES ENTERTAINMENT

General.—Mrs. R. S. Knappen, chairman; Mrs. L. Murray Neumann, co-chairman.

Tea.—Mrs. H. H. Power, chairman; Mrs. W. B. Wilson, co-chairman.

Receiving Line.—Mrs. A. I. Levorsen, Mrs. William B. Heroy, Mrs. Frank R. Clark, Mrs. Frederic H. Lahee, Mrs. Lovic P. Garrett, Mrs. Sidney Powers, Mrs. J. Y. Snyder, Mrs. R. S. McFarland, Mrs. G. C. Gester Mrs. E. L. DeGolyer, Mrs. James H. Gardner, Mrs. Max W. Ball, Mrs. W. E. Wrather, Mrs. Geo. C. Matson, Mrs. Wallace E. Pratt, Mrs. Alexander Deussen, Mrs. J. Elmer Thomas.

Presiding at Tea Tables.—Mrs. R. B. Rutledge, Mrs. Ed. Bloesch, Mrs. Frank A. Morgan, Mrs. E. C. Moncrief, Mrs. L. C. Snider, Mrs. Monroe G. Cheney, Mrs. Edwin B. Hopkins, Mrs. H. B. Goodrich.

Registration.—Mrs. L. F. McCollum, chairman; Mrs. Roscoe Shutt, co-chairman.

Tulsa Locale.—Mrs. B. B Weatherby, chairman; Mrs. Stuart Sherar, co-chairman.

Luncheon.—Mrs. Richard T. Lyons, chairman; Mrs. Richard Hughes, co-chairman.

Hostess.—Mrs. A. L. Beekly, chairman; Mrs. A. F. Truex, co-chairman.

Transportation.—Mrs. Lyndon L. Foley, chairman; Mrs. J. P. D. Hull, co-chairman.

SCHEDULE OF EVENTS

The following schedule of events and the technical program are taken from the printed program distributed at the convention.

TUESDAY, MARCH 17 (PRE-CONVENTION)

7:00 P.M. Executive Committee, A. I. Levorsen, chairman

WEDNESDAY, MARCH 18 (PRE-CONVENTION)

Registration. South Mezzanine, Mayo Hotel

9:00 A.M. Committee on applications of geology, Frank Rinker Clark, chairman, French Room, Mayo Hotel

9:00 A.M. Committee on geologic names and correlation, Ira H. Cram, chairman, Room B, Mezzanine, Mayo Hotel

10:00 A.M. Executive committee and finance committee, joint meeting

10:00 A.M. Society Petroleum Geophysicists, executive committee and business committee, joint meeting, French Room, Tulsa Hotel

2:00 P.M. General business committee, H. B. Fuqua, chairman; H. W. Hoots, vice-chairman; Junior Ball Room, Mezzanine, Mayo Hotel

6:30 P.M. Informal dinner, research committee, followed by round table discussion of "Variation of Occurrences and Character of Oil and Gas with Variation of Stratigraphic Facies." Open to all Association members.

THURSDAY, MARCH 19 (CONVENTION)

7:30 A.M.	Registration. South Mezzanine, Mayo Hotel
9:00 A.M.	Society Petroleum Geophysicists business meeting. Art Moderne Room, Tulsa Hotel
9:45 A.M.	Address of welcome and response. Crystal Ball Room, Mayo Hotel*
10:30 A.M.	General technical session. Crystal Ball Room, Mayo Hotel
10:30 A.M.	Technical session, Society of Petroleum Geophysicists. Art Moderne Room, Tulsa Hotel
12:00 M.	Geophysicists' luncheon, Tulsa Hotel
1:30 P.M.	Technical session, Society of Petroleum Geophysicists. Papers of general interest. Crystal Ball Room, Mayo Hotel
1:45 P.M.	Stratigraphic session. Ball Room, University Club
3:00 P.M.	Musical tea for ladies of A.A.P.G., Oakhurst Country Club
4:45 P.M.	Announcements, nomination of officers, appointment of committees. Crystal Ball Room, Mayo Hotel
8:00 P.M.	Smoker. Dr. Barnum Brown's lecture on the New Dinosaur Kingdom. Crystal Ball Room, Mayo Hotel

FRIDAY, MARCH 20 (CONVENTION)

8:00 A.M.	Ballot boxes open, Association booth. South Mezzanine, Mayo Hotel
9:00 A.M.	General technical session—continued. Crystal Ball Room, Mayo Hotel
9:00 A.M.	Technical session, Society of Economic Paleontologists and Mineralogists. Junior Ball Room, Mezzanine, Mayo Hotel
9:00 A.M.	Technical session, Society of Petroleum Geophysicists. Art Moderne Room, Lobby Floor, Tulsa Hotel
12:30 P.M.	College and fraternity luncheons
12:30 P.M.	Paleontologists' luncheon. Rooms A and B, Mezzanine, Mayo Hotel
12:30 P.M.	Spring luncheon with fashion review for ladies of A.A.P.G. Tulsa Country Club
1:00 P.M.	Golf tournament for Bostick Cup, Tulsa Country Club
1:30 P.M.	Technical session, Society Petroleum Geophysicists. Art Moderne Room, Lobby Floor, Tulsa Hotel
1:45 P.M.	General technical session—continued. Crystal Ball Room, Mayo Hotel
2:00 P.M.	Technical session, Society of Economic Paleontologists and Mineralogists. Junior Ball Room, Mezzanine, Mayo Hotel
4:00 P.M.	Annual business meeting, Society of Economic Paleontologists and Mineralogists. Junior Ball Room, Mezzanine, Mayo Hotel
7:30 P.M.	Banquet and dance. Mayo Hotel and University Club (opposite Mayo)

SATURDAY, MARCH 21 (CONVENTION)

9:00 A.M.	Twenty-first annual business meeting. Announcement of elections. Crystal Ball Room, Mayo Hotel
10:00 A.M.	Executive committees, joint meeting 1935 committee and 1936 committee
10:00 A.M.	General technical session—continued. Crystal Ball Room, Mayo Hotel
10:00 A.M.	Technical session, Society of Petroleum Geophysicists. Art Moderne Room, Lobby Floor, Tulsa Hotel
1:45 P.M.	General technical session—concluded. Crystal Ball Room, Mayo Hotel

SATURDAY, MARCH 21 (FIELD TRIP)

Seminole and Fitts Oil Fields and Arbuckle Mountains

1:30 P.M.	Lv. Mayo Hotel by bus. Via Stroud and Seminole oil field. Sulphur, Oklahoma. Hotel Artesian, Saturday evening, discussion led by C. W. Tomlinson.

SUNDAY, MARCH 22 (FIELD TRIP)

8:00 A.M.	Sulphur and Davis, Oklahoma. Study of Ordovician rocks, led by Charles E. Decker
12:00 M.	Luncheon, Aldridge Hotel, Ada
1:00 P.M.	Unveiling of the John Fitts memorial to David White on East Central State Teachers College campus, Ada
1:30 P.M.	Lv. campus for Fitts field; description by D. L. Hyatt, Carter Oil Company. Simpson group in Murray's Lane under leadership of Dr. Decker. Bus returns to Tulsa in evening. Round trip fare, $4.00, meals and lodging not included.

Technical Program

I. General Association Papers for Oral Presentation

1. A. I. Levorsen, Presidential Address. Stratigraphic vs. Structural Accumulation
2. W. H. Twenhofel, Presidential Address. Marine Unconformities, Marine Conglomerates and Thicknesses of Strata
3. R. D. Reed, Structural Evolution of Southern California
4. Joseph E. Pogue, The Price of Crude Oil in Perspective
5. Robert Roth, Notes on the Base of the Custer
6. Glenn Grimes, Revision of Pennsylvanian-Permian Contact on North American Continent
7. Darsie A. Green, The Pre-Marlow Permian of Central Oklahoma
8. W. B. Lang, The Stratigraphy of the Permian Rocks in Southeastern New Mexico. Presented by Hugh D. Miser
9. Ernest A. Obering, Salt Deposition in the Permian Basin
10. Robert H. Dott, Some Pennsylvanian Correlations in East Central Oklahoma
11. T. A. Hendricks, C. H. Dane, M. M. Knechtel, Stratigraphy of the Arkansas-Oklahoma Coal Basin. Published by permission of the director, United States Geological Survey
12. Charles E. Decker, Some Tentative Correlations on the Basis of Graptolites of Oklahoma and Arkansas
13. Josiah Bridge, T. A. Hendricks, M. M. Knechtel, The Geology of Black Knob Ridge, Oklahoma. By permission of the director, United States Geological Survey
14. H. B. Stenzel, The Rim Syncline of the Marquez Salt Dome, Texas
15. Michel T. Halbouty, High Island Salt Dome, Galveston County, Texas. By permission of Yount-Lee Oil Company and Stanolind Oil and Gas Company
16. J. Boyd Best, West Tuleta, Dirks, and Ray Oil Fields, Bee County, Texas
17. S. W. Lowman, Central Oklahoma Uplift
18. Don L. Hyatt, Fitts Oil Field, Pontotoc County, Oklahoma
19. H. S. McQueen, Pre-Mississippian Structural History of the Ozark Uplift of Southern Missouri. By permission of the State Geologist, Missouri Geological Survey, Rolla, Missouri
20. N. W. Bass, Constance Leatherock, W. R. Dillard, and L. E. Kennedy, Characteristics and Origin of the Bartlesville and Burbank Sands in Osage and Kay Counties, Oklahoma, and Cowley, Butler and Greenwood Counties, Kansas. By permission of the director, United States Geological Survey
21. John Emery Adams, Oil Pool of Open Reservoir Type
22. W. A. Ver Wiebe, Geosynclinal Boundary Faults

Symposium on Currently Active Fields

23. Howard S. Bryant, Kansas
24. Edward F. Shea, Oklahoma
25. Theron Wasson, Oil and Gas fields of Michigan with Particular Reference to Recent Developments
26. William B. Heroy, Foreign Fields
27. Orval L. Brace, Gulf Coast
28. Harry H. Nowlan, San Antonio District
29. Wallace Ralston, East Texas
30. H. Rogers Van Gilder, North Appalachian Province of Oriskany Production in New York and Pennsylvania
31. Henry V. Howe, Stratigraphic Evidence for Gulf Coast Geosyncline
32. C. W. Tomlinson, Structural History of the Criner Hills, Oklahoma
33. C W. Tomlinson, Opposed Thrusts on Scissor Faults in Southern Oklahoma
34. Watson Monroe, Factors Affecting the Geologic History of the Jackson Area, Mississippi. By permission of the director, United States Geological Survey
35. Richard B. Rutledge and Howard S. Bryant, Cunningham Field, Kingman and Pratt Counties, Kansas
36. F. G. Clapp, Geology and Bitumens of Dead Sea Area, Palestine and Transjordan
37. D. D. Utterback and W. V. Howard, Bituminous Limestones and Sandstone
38. Parker D. Trask, Studies of Some Possible Source Beds in Oklahoma and Kansas. By permission of the director, United States Geological Survey. A paper resulting from an investigation on source beds, supported jointly by the United States Geological Survey and the American Petroleum Institute

SYMPOSIUM ON CURRENTLY ACTIVE FIELDS

39. Robert Roth, North Texas
40. Harold W. Hoots, California
41. Hal P. Bybee, West Texas and Southeastern New Mexico
42. E. A. Stiller, Review and Preview of Comanche Production in Louisiana and Southern Arkansas
43. Basil B. Zavoico, Recent Developments in the Oil Fields of U.S.S.R.
44. James H. Gardner, Correlation of Orogenic and Structural Trends in the Wichita, Arbuckle, and Ouachita Areas of Oklahoma and the Adjacent Portion of Texas
45. George C. Branner, Sandstone Porosities in the Paleozoic Region of Arkansas
46. Frank Rieber, Visual Presentation of Elastic Wave Patterns Under Various Structural Conditions
47. W. Armstrong Price, Tentative Glacial Time Scale for Gulf Coast Quaternary Formations
48. H. A. Ireland, The Use of Insoluble Residues for Correlation in Oklahoma

II. GENERAL ASSOCIATION PAPERS FOR PRESENTATION BY TITLE

49. Frank A. Morgan, Oil Field Discoveries in California in Retrospect
50. W. W. Love and W. V. Howard, Experimental Evidence on Migration of Petroleum, Parts I and II
51. Albert W. Weeks, Miocene, Pliocene, and Pleistocene Formations in the Rio Grande Region, Starr and Hidalgo Counties, Texas
52. R. Clare Coffin, Peculiarities in the Distribution of Oil and Gas in the Fields of the Rocky Mountain Region
53. Wallace Lee, Mississippian Limestone of Kansas
54. R. W. Richards, Significance of Wet, Lean and Dry Gas to the Absence and Presence of Petroleum Deposits
55. Frank A. Melton, Fractures in Hard Strata Above Oklahoma City Structure
56. Lee C. Lamar, The South Burbank Pool
57. E. B. Branson and M. G. Mehl, Devonian-Mississippian Contact in South-Central Oklahoma and Correlation of Formations Involved
58. Henry Schweer, Notes on the Northwest Extension of the Buried Arbuckle Mountains

III. PALEONTOLOGY AND MINERALOGY

1. R. W. Harris, Additional Ostracods from the Simpson and Arbuckle of Oklahoma
2. F. B. Plummer, A New Classification for Paleozoic Ammonoids
3. Constance Leatherock, Physical Characteristics of the Bartlesville and Burbank Sands in Northeastern Oklahoma and Southeastern Kansas. By permission of the director, United States Geological Survey
4. L. A. Johnston, Some New Species of the Genus Graphiodactylis
5. N. L. Thomas, Extinction, an Aid in Correlation
6. Maxim K. Elias, Some Aspects of Classification of North American Fusulinids
7. C. E. Decker, Graptolites of the Stringtown Shale and Basal Viola Limestone of Oklahoma and Womble Shale of Arkansas
8. C. E. Decker, A Cambrian Graptolite Fauna in the Middle Arbuckle Limestone of Oklahoma
9. C. E. Decker, The Didymograptus Protobifidus Zone in the Arbuckle Mountains, Oklahoma and Near Smithville, Arkansas
10. C. E. Needham, Fusulinids from the Pennsylvanian and Permian Rocks of New Mexico and Their Stratigraphic Significance
11. Norman D. Newell, The Chautauqua Arch and Pennsylvanian Sedimentation
12. Alice Quesenbery and J. A. Butts, Microscopic Fossils from an East Texas Oil Well
13. H. B. Stenzel and R. W. Cumley, Speed of Deposition of Glauconitic Sediments
14. Henry W. Howe, On Some Large Oysters of the Gulf Coast Tertiary
15. H. I. Durgan and L. W. Calahan, Micro-Faunal Range-Chart Involving an Eocene-Oligocene Section in South Texas-Northern Mexico
16. M. M. Kornfeld, Use of Corals in Jackson Eocene Well Cuttings
17. Cecil G. Lalicker and E. R. Applin, Some New Tertiary Textulariidae from Texas and Louisiana
18. Morton B. Stephenson, Shell Structure of the Ostracode Genus Cytheridea
19. M. P. White, Geological Research, Division of Foraminifera

20. GAYLE SCOTT, The Ammonites of the Trinity Group, Exclusive of the Malone Formation, in Texas, Arkansas and Louisiana
21. J. W. STOVALL, Vertebrate Evidence of Jurassic in Cimarron County, Oklahoma
22. DAN J. JONES, Insect Wings from the Nowata Shale

IV. GEOPHYSICS

1. B. GUTENBERG, Some Theoretical Problems Concerning the Seismic Methods
2. M. M. SLOTNICK, On Seismic Calculations, II
3. E. E. BLONDEAU, Earth Temperature Measurements over Two Known Structures
4. L. A. BURROWS, Relation Between Firing Current and Performance in Seismograph Caps
5. C. E. VAN ORSTRAND, Preliminary Report on Geothermal Methods of Estimating the Age of the Earth
6. DONALD C. BARTON and ETHEL WARD MCLEMORE, Crosbyton Magnetic and Gravitational Anomaly, Crosby, Garza, Dickens and Kent Counties, Texas
7. B. B. WEATHERBY, The Organization of an Effective Exploration Department. Presidential Address
8. T. I. HARKINS, The Geophysical History of the Darrow Salt Dome, Ascension Parish, Louisiana
9. T. I. HARKINS, Geophysical History of the Mykawa Oil Field, Harris County, Texas
10. J. H. WILSON, A Recommended Program for the Exploration of the Great Plains
11. FRANK RIEBER, Controlled Directional Sensitivity. A Method for Adapting Reflection Methods to Complex Structures
12. J. BRIAN EBY, Magnetic Survey of Southwest Alabama
13. J. B. MACELWANE, Absolute and Relative Energy Relations in the Reflection and Refraction of Elastic Waves
14. C. E. VAN ORSTRAND, Preliminary Report on the Geothermal Gradients in the Oriskany Sand in New York, Pennsylvania and West Virginia
15. PAUL W. KLIPSCH, Some Aspects of Multiple Recording
16. A. A. BRYAN, The Ground Motion from Mechanical Seismograph Records
17. LOUIS STATHAM, Electrical Earth Transients in Geophysical Prospecting
18. F. J. G. NEUMANN, Torsion-Balance Surveying on Inundated Areas
19. JOHN M. IDE, An Experimental Study of the Elastic Properties of Rocks
20. L. D. LEET, A Refraction and Reflection Fan to 187.8 KM
21. E. A. ECKHARDT, Comparative Torsion-Balance and Gravimeter Survey
22. E. E. ROSAIRE and K. RANSOME, The Growth of Company-Owned Operations in Gulf Coast Geophysical Exploration Since 1930
23. L. J. NEUMAN, The Diving Rod
24. FREDERICK A. TOMPKINS, Effect of Development Time and Developer Temperature on the Production of Photographic Seismograph Records
25. C. A. HEILAND, Notes on Reflections from Steeply Dipping Beds
26. L. Y. FAUST, Optimum Geophone Spreads for Reflection Surveys
27. L. D. LEET and H. G. TAYLOR, True Horizontal Displacements Near a Five-Ton Blast
28. J. A. SHARPE, Simple Formulae of Three-Dimensional Dip Shooting
29. J. BARAB, J. M. MARTIN and H. E. NASH, Significance of Some Fundamental Properties of Explosives, with Special Reference to Geophysical Prospecting
30. R. R. THOMPSON, The Seismic Electric Effect and Its Use in Recording Seismic Waves
31. M. M. SLOTNICK, A Simplified Circuit of the Seismic Electric Method and Its Steady State Solution
32. N. G. JOHNSON and G. H. SMITH, Explosives for Seismic Prospecting
33. CHARLES GILL MORGAN, Geophysical Studies in Antarctica

MINUTES, TWENTY-FIRST ANNUAL BUSINESS MEETING
MAYO HOTEL, TULSA, OKLAHOMA
MARCH 19–21, 1936

A. I. LEVORSEN, *presiding*

The meeting was called to order at 4:30 P.M., March 19, 1936, by A. I. Levorsen, president, E. C. Moncrief serving as secretary.

1. *Election of honary members.*—The election of W. A. J. M. van der Gracht and E. O. Ulrich to honorary membership in the Association was announced by president Levorsen.

2. *Nominations of officers.*—The president called for nominations of the Association for the ensuing year. The following nominations were made.

For president:	Ralph D. Reed, nominated by Fritz L. Aurin
For vice-president:	C. E. Dobbin, nominated by L. W. Kesler
	Jerry B. Newby, nominated by J. B. Umpleby
For secretary-treasurer:	Charles H. Row, nominated by M. G. Cheney
For editor:	L. C. Snider, nominated by James H. Gardner

3. *Ballot committee.*—The president appointed the following to serve as the ballot committee: John G. Bartram, chairman; H. W. Hoots, Herschel H. Cooper.

4. *Resolutions committee.*—The president appointed the following resolutions committee: M. G. Cheney, chairman; Chester Cassel, Theron Wasson.

The meeting adjourned at 5:05 until March 21, 1936, at 9:00 A.M.

The adjourned meeting was called to order at 9:30 A.M., March 21, 1936, by president A. I. Levorsen.

5. *Reading of minutes.*—It was moved, seconded, and carried that the reading of the minutes of the annual meeting held at Wichita, Kansas, March 21–23, 1935, be dispensed with, inasmuch as they had been published in the *Bulletin.*

6. *Report of officers.*—The reports of president A. I. Levorsen, secretary-treasurer E. C. Moncrief, and editor L. C. Snider were read (Exhibits I, II, and III).

7. *Report of general business committee.*—The report of the general business committee (Exhibit IV) was made by the chairman, H. W. Hoots. The recommendations contained therein were on motion adopted. (The reports of the committee on geologic names and correlations, Ira H. Cram, chairman; of the research committee, Donald C. Barton, chairman; of the committee on application of geology, Frank R. Clark, chairman; and of the representative of the Association on the National Research Council Division of Geology and Geography, Donald C. Barton, unofficial representative, appear as Exhibits V, VI, VII, and VIII, respectively.)

8. *Report of resolutions committee.*—The report of the resolutions committee (Exhibit IX) presented by M. G. Cheney, was unanimously adopted.

9. *Report of ballot committee.*—The ballot committee reported (Exhibit X) the election of the following officers: president, Ralph D. Reed; vice-president, C. E. Dobbin; secretary-treasurer, Charles H. Row; editor, L. C. Snider.

10. *Introduction of new officers.*—The newly elected officers of the Association were introduced by retiring president Levorsen.

The twenty-first annual business meeting adjourned at 10:15 A.M.

A. I. Levorsen, *president* E. C. Moncrief, *secretary*

Exhibit I. Report of President

(Year Ending March 21, 1936)

This report is designed to give you very briefly some of the more important features of the activities of the Association during the past year. More detailed reports will be presented by secretary-treasurer Moncrief and editor Snider. We greatly regret that vice-president Morgan, who has

been particularly active throughout the year in the affairs of the Association, was detained at the last minute and is therefore unable to attend our meeting.

Three or more members of the executive committee met during the past year on the Kansas Geological Society field trip in Iowa, at the A.P.I. meeting in Los Angeles and at the time of the G.S.A. meeting in New York, in addition to the meeting last year in Wichita and again preceding the present convention.

Your president has met with a number of the local societies including the Pacific Section in Los Angeles, Kansas Society field trip, Shreveport Society field trip, San Antonio Section's annual meeting in Mexico City, and the Oklahoma City, Tulsa, Fort Worth, Midland, Amarillo, North Texas, Shreveport, East Texas and Dallas geological societies. These meetings have been particularly enjoyable and constitute one of the most interesting experiences of being president of this Association. Everywhere there was a keen interest in geological problems and in the affairs of the Association.

MID-YEAR MEETING

At the invitation of the San Antonio Section, your executive committee designated their annual meeting as the mid-year meeting of the Association. This was held at Mexico City, October 16–20, 1935, at which time 278 were registered and there were approximately 350 present at the first meeting. Two morning sessions were held at which technical papers were presented and, in addition, a wide variety of entertainment, field trips and excursions were arranged by the committee. I think that this meeting was well worth while and it enabled many of us to become better acquainted with the geologists of the Republic of Mexico and the geologists working in Mexico for commercial oil campanies.

As a direct result of this meeting, your executive committee elected Señor Ezequiel Ordoñez as an honorary member of the Association; we also presented to the library of the Geologic Institute of Mexico a set of our special volumes, suitably inscribed in both English and Spanish, in consideration of the many hospitalities and courtesies which they extended to us at the time of the mid-year meeting; and the April issue of our *Bulletin* is devoted entirely to articles on the geology of Mexico, most of which were presented at the mid-year meeting. The road logs, both written and mapped of the 1934 and 1935 field trips of the San Antonio Society, are given together with other material which would be of value to any geologist ever making the trip to Mexico City, either by car or by train.

PUBLICATIONS

Bulletin.—One of the chief interests of the Association is the publication of our monthly *Bulletin*. We have had the same problem in the last year as has been encountered in several years previous in that there has been a hesitancy on the part of members in presenting papers and articles for publication. This situation becomes acute in January and February when the supply of papers from the preceding meeting has been exhausted and when new papers are held up for the coming meeting. With a membership as large as ours, however, there should always be an ample supply of articles for publication and it is up to each one individually to give thought to this problem.

It might interest you to know that during each year since the Association

began there has been an average of only 6 per cent of our members who have contributed towards our publications. The organizations to which most of these contributors belong, in the order of total number of contributors to Association publications are as follows.

Consulting geologists	233
Members at universities	198
U. S. Geological Survey members	119
State Geological Survey members	67
Humble Oil Company geologists	63
Gulf Companies geologists	63
Sun Company geologists	44
Marland-Continental geologists	37
Amerada Petroleum Corporation geologists	34
Standard of California Company geologists	24

It is not necessary that everyone write articles for our publications but certainly everyone can give encouragement to those who will make the effort. Ordinarily it merely requires a helping hand or some encouragement or interest in another's work to get from him an article or item of interest to our members for publication in the *Bulletin*. The *Bulletin* offers to each of our members an unequalled opportunity to present his views and ideas to a large group of geologists and offers a practical way whereby he can do his share in furthering the aims of our Association.

Gas Volume.—The *Geology of Natural Gas*, edited by Henry Ley, was issued last August; 2,500 copies were printed of which 1,500 were bound; 1,102 have been sold to date which indicates this as one of our popular special volumes. It contains a wide variety of articles and should be in the library of every geologist whether he is interested in either oil or gas. Mr. Ley and the other authors who contributed to this volume deserve the congratulations and thanks of the membership for the excellence of their work and for their generosity in time and effort which went into the preparation of this volume. The cost of publishing the gas volume is approximately equal to the selling price and it is necessary that each member make a special effort to purchase a copy if we are to avoid a deficit.

Geology of Tampico Embayment.—The publication of the *Geology of the Tampico Embayment* by John M. Muir has reached the galley proof stage and promises to be a real contribution to the geology of Mexico and a publication of which we may all be proud. It is anticipated that it will have 350 pages or approximately the size of Reed's *Geology of California;* that it will sell for $3.50 per copy to members and $4.50 to non-members; and that it will be issued some time within the next three months.

Index.—Your executive committee has authorized the preparation of a comprehensive index of all Association publications. This is now being done during half of Miss Heath's time and should be ready for distribution by March, 1937. It is planned to issue it with paper cover, free to all members. The Index will be chiefly a finding list designed to meet the needs of the average commercial geologist and therefore is being compressed to 300 or 350 pages.

Geology of Gulf Coast Oil Fields.—It is now anticipated by Donald C. Barton and George Sawtelle, editors, that the special volume, *Gulf Coast Oil Fields*, should be ready for printing by July 1st. This special volume will consist of articles previously published in the *Bulletin* which pertain to the geology of the Gulf Coastal area of the United States.

RESEARCH COMMITTEE

Donald Barton, chairman of the Research Committee, has developed one of the most important and valuable contributions to our annual convention in the Round Table discussions which precede the opening of the session. This year the subject was "Effect of Facies Changes on Origin of Oil and Gas Content" and several hundred were in attendance at the meeting held Wednesday evening. Discussion is unrestrained, undirected and extremely informal. The number participating in discussions shows the approval which our membership gives to this feature of the program of the Research Committee.

COMMITTEE ON APPLICATIONS OF GEOLOGY

This committee under the chairmanship of Frank R. Clark reports continued progress on many fronts in presenting geology to the public. Each member is urged to carefully read the detailed report of this committee and thereby become familiar with its work. The work of this committee should not be confined to the members of the committee but should be considered by every member of the Association as part of his obligation not only to the Association but to society.

MEMBERSHIP

Our membership is increasing at a very pleasing rate. During the year 140 members and associates have been elected and have accepted membership, and in addition there are at present 62 applications passing through the channels preparatory to election. Of the 573 who were dropped for non-payment of dues since 1933 and for whose particular benefit our by-laws were amended last year to permit easy reinstatement, 148 have availed themselves of the opportunity. Three persons were elected by the executive committee to honorary membership during the year. The total additions in all classes amount to 288. Offsetting this there has been a loss through death, resignation and separation because of non-payment of dues of 92 members with a net result of an increase of 196 over the total of a year ago.

Your executive committee feels that the reduction in dues was a very wise move and has contributed largely to the increased interest in the Association. The loss in revenue through reduction in amount of dues is, and will continue to be, compensated through the increase in membership, and at this time it would seem as though the present dues will be sufficient to take care of the requirements of the Association for some time to come.

There are a large number of geologists who are working in petroleum geology who are not yet members and each member can contribute to the good of the Association by locating those who might become members and assisting and encouraging them to file an application.

Deceased Members.—The members and associate deceased since the last annual meeting were as follows.

MEMBERS

Clyde M. Bennett	Charles T. Lupton
Samuel J. Caudill	Russell F. Ryan
Leo S. Fox	Jan Versluys

ASSOCIATE

Charles D. Gleason

Honorary Members.—The following were elected to honorary membership in the Association during the past year by your executive committee under the provisions of Section 6, Article III of our Constitution which provides that:

> The executive committee may from time to time elect as honorary members persons who have contributed distinguished service to the cause of petroleum geology.

Ezequiel Ordoñez, Mexico City
W. A. J. M. van der Gracht, Heerlen, Holland
E. O. Ulrich, Washington, D. C.

DIVISION OF PALEONTOLOGY AND MINERALOGY

The Society of Economic Paleontologists and Mineralogists, a division of the Association, has continued its progress of previous years. Its total membership now numbers 288. Eight issues of the *Journal of Paleontology* were published during the last year, of which half were prepared by the Society of Economic Paleontologists and Mineralogists and half were prepared by the Paleontological Society with whom a joint publishing arrangement has been perfected. This arrangement has been of mutual benefit.

DIVISION OF GEOPHYSICS

The Society of Petroleum Geophysicists, a Division of the Association, now has a membership of 325, an increase of 139 over a year ago. Two issues of their special publication, the *Journal* of the Society of Petroleum Geophysicists have been published. The first containing six articles was published in July, 1935, and the second containing 12 articles was distributed this week. The increase in interest in this Division is very gratifying to everyone and its plans are for a continued expansion during the coming year.

FINANCES

The Association has ample funds to conduct any of the activities which in the opinion of the executive committee are necessary to the interest of our members without the sale of any of our bonds or securities.

The wise course to follow in the handling of our investments is one of the most serious problems of a new executive committee. Ordinarily it requires several months before the information can be developed which will permit an incoming executive committee to get the proper background with which to judge intelligently the requirements of the Association. This is particularly true now when financial conditions are changing rapidly,—bonds are being called for re-issue at lower interest rates and a large percentage of the best financial advice is changing its position with respect to the purchase of common stock equities by trust funds, universities and other groups whose financial problems are parallel with our own.

Your executive committee, with advice from the finance committee, who have been generous with their time, are of the opinion that the only sound procedure is for the Association to employ someone who will give individual, continuing expert attention to our securities and who will present from time to time carefully considered general and specific recommendations on our investments. This is one of the most pressing of our present problems and is to be considered at the joint meeting of the executive committee this afternoon.

The privilege and honor of being president of this Association is one of the most worthwhile experiences that can happen to any geologist. I never before realized the tremendous amount of good-will, friendliness and thoughtfulness which our membership radiates, and the opportunity of serving it in any capacity is a real privilege. I am particularly grateful for the sympathetic cooperation of the members of the executive committee; for the sincere interest of the headquarters' staff in the affairs of the Association and the many courtesies and services which they have tendered me; and to the members of the various committees who are carrying forward the objects of the Association. The thanks of all who attended this meeting are due the Tulsa Geological Society for the splendid manner in which they have put on this convention. Facilities have been such that ideas could be put across to those who attended the technical sessions, and there is no reason why any one who came to this meeting should not have been able to return home with a large supply of new ideas.

As the present executive committee has had the hearty coöperation of all those who have served on the executive committees in the past, so you may be assured we will assist in every way possible the new officers in what promises to be a still bigger year than the last.

A. I. LEVORSEN, *president*

EXHIBIT II. REPORT OF SECRETARY-TREASURER

(Year Ending March 21, 1936)

The year 1935 was a successful one for the Association, judged by the increase in membership, reinstatement of old members, smaller numbers in arrears, and a reasonable profit.

MEMBERSHIP

The Association will miss the presence of the following members who have passed away during the last year: Clyde M. Bennett, Leo S. Fox, Charles T. Lupton, S. J. Caudill, Russell F. Ryan, Jan Versluys, Charles D. Gleason.

The membership of the Association reached its peak in 1931 with a total of 2,562 members and each year since has shown a decline until the past year. The year 1935 shows an increase of 196 members over 1934 and the total membership on March 1, 1936 was 2,169. This increase in membership is due to the general improvement of business conditions and to the amended By-Laws providing special reinstatement for members dropped between the dates of January 1, 1931, and January 1, 1936, passed by the executive committee in March, 1935.

The Association has added to its membership 140 new members and reinstated 148 old members during the year of 1935. On March 1, 1936, there was a total of 80 applications for new membership and reinstatement of old members on hand. It appears very probable that this increase will continue through 1936 and the following years until our membership will regain its peak of 1931 and even surpass that number. Tables I, II, and III give the details of the membership of the Association.

FINANCES

GENERAL

The finances of the Association show a net profit of $5,690.73 for 1935, due chiefly to the payment of accounts charged off, reinstatement of old members, and advance in the value of investments. This profit was derived from the funds as follows.

General Fund	$3,012.95
Publication Fund	2,466.09
Research Fund	211.69

The Geophysics Division and the Paleontology and Mineralogy Division report a satisfactory financial condition at the close of the year.

The audit of the Association's books for the fiscal year ending December 31, 1935, has been made and the auditors' report published in the March, 1936, issue of the *Bulletin*. Summaries and comparisons of recent years are set out in detail in Tables IV, V, VI, VII.

ASSETS AND LIABILITIES

The audit of December 31, 1936 (published in March issue of the *Bulletin*) shows Assets totaling $92,372.78 and Liabilities $12,910.37, or net assets of $80,462.41, divided as follows.

General Fund	$56,425.14
Publication Fund	22,616.62
Research Fund	1,420.65

Liabilities of $12,910.37 are divided as follows.

Dues, Subscriptions and Advertising paid in advance	$10,360.58
Accounts Payable	1,549.79

Approximately 60 per cent of the assets are in investments which are carried at the lower figure of cost or current market value; approximately 28 per cent of the assets are publications carried at a very conservative inventory value.

The cash on hand December 31, 1935, shows as $17,782.31, exclusive of $10,029.19 in Certificate of Deposit and temporary Savings Account.

REVENUES AND EXPENSES

The revenues and expenses for the past three years are summarized in Tables IV, V, VI.

General Fund.—The Association's revenues were reduced approximately $3,500 by the reduction in the annual dues and no change was made in the amount set aside to represent the cost of the subscriptions to the *Bulletin;* thus the General Administrative Expense shows a loss of $1,734.00. This expense increased $3,012.45 over the previous year, due chiefly to the advanced costs of all supplies, additional clerical expense, additional rent due to the enlargement of office space and additional donations.

Bulletins.—The cost of the bulletins for 1935 shows an increase of $1,494.00 over 1934, due to the printing of 1,855 more copies and 212 more pages than in 1934, the cost per copy remaining the same at 55¢.

The Net Income for advertising in the *Bulletin* increased $2,104.00 or 87 per cent over 1934.

Investments.—In February, 1936, in accordance with the wishes of the Executive and Finance Committees, the General Fund Investments were increased $10,698.75 by purchase of additional bonds, making a total of $36,122.25.

Publication Fund.—The Geology of Natural Gas was published this year at a cost of $9,774.99 and the sale of the same yielded an income of $4,453.40. This fund shows a net accrued profit of $2,466.09, due to the sale of publications and interest received in the amount of $727.15.

Research Fund.—This fund was inactive during the year except for $61.79 received as interest and the expenditure of $57.60 for expenses of the Committee.

BUDGETS

The probable receipts and expenditures for the fiscal year of 1936 are shown in Table X.

The Secretary-Treasurer has received the fullest coöperation from the Executive and Finance Committees and the membership of the Association. The Business Manager and Headquarters Staff have rendered faithful service and were largely instrumental in making 1935 a successful year.

E. C. MONCRIEF, *secretary-treasurer*

TABLE I

TOTAL MEMBERSHIP BY YEARS

May 19, 1917	94	March 1, 1927	1,670
February 15, 1918	176	March 1, 1928	1,952
March 15, 1919	348	March 1, 1929	2,126
March 18, 1920	392	March 1, 1930	2,292
March 15, 1921	621	March 1, 1931	2,562
March 8, 1922	767	March 1, 1932	2,558
March 20, 1923	901	March 1, 1933	2,336
March 20, 1924	1,080	March 1, 1934	2,043
March 21, 1925	1,253	March 1, 1935	1,973
March 20, 1926	1,504	March 1, 1936	2,169

TABLE II

COMPARATIVE DATA OF MEMBERSHIP

	March 1, 1935		*March 1, 1936*	
Number of honorary members	8		11	
Number of life members	2		2	
Number of members	1,591		1,732	
Number of associates	372		424	
Total number of members and associates		1,973		2,169
Increase in membership		—		196
New members and associates	—		140	
Reinstatements	—		148	
Total new and reinstatements		—		288
Decrease in membership		70		—
Applicants elected, dues unpaid	6		11	
Applicants approved for publication	23		20	
Recent applications	21		31	
Total applications on hand		50		62

TABLE II (*Continued*)

	March 1, 1935		March 1, 1936	
Applications for reinstatement elected, dues unpaid	—		8	
Recent applications for reinstatement	—		10	
Total applications for reinstatement on hand				18
Applications approved for transfer, dues unpaid	8		7	
Applications for transfer approved for publication	5		19	
Recent applications for transfer on hand	7		26	
Total applications for transfer on hand		20		52
Number of members and associates withdrawn	10		3	
Number of members and associates dropped	152		82	
Number of members and associates died	12		7	
Total loss in membership		174		92
Total gain in membership		—		196
Number of members and associates in arrears, previous year	184		129	
Members in arrears, current year	733		497	
Associates in arrears, current year	191		142	
Total number members and associates in arrears, current year		924		639
Total number members and associates in good standing		1,049		1,401

TABLE III

GEOGRAPHIC DISTRIBUTION OF MEMBERS

March 1, 1936

Arizona	1	Louisiana	78	North Carolina	1
Arkansas	6	Maine	1	Ohio	5
California	235	Maryland	3	Oklahoma	401
Colorado	45	Massachusetts	9	Pennsylvania	44
Connecticut	3	Michigan	23	South Dakota	2
Delaware	1	Minnesota	4	Tennessee	3
Dist. of Columbia	30	Mississippi	5	Texas	703
Florida	7	Missouri	25	Utah	2
Illinois	20	Montana	9	Virginia	1
Indiana	5	Nebraska	4	Washington	3
Iowa	6	New Jersey	7	West Virginia	15
Kansas	94	New Mexico	17	Wisconsin	4
Kentucky	5	New York	71	Wyoming	11

Total members in United States 1,909

Africa	3	Dutch East Indies	12	Peru	2
Arabia	5	Dom. Republic	1	Philippine Islands	1
Argentina	19	England	13	Poland	2
Australia	5	France	11	Roumania	5
Austria	4	Germany	10	Russia	2
Belgium	1	Holland	17	Scotland	4
Brazil	1	Iraq	3	Sicily	1
B. West Indies	7	Italy	2	Spain	1
Canada	18	Japan	4	Sweden	1
Colombia	10	Madagascar	1	Switzerland	11
Cuba	3	Mexico	26	Turkey	3
Czechoslovakia	1	Palestine	1	Venezuela	49

Total members in foreign countries 260

Grand total 2,169

TABLE IV

COMPARISON OF ACCRUED INCOME BY YEARS

	1933	1934	1935
Dues			
Members	$17,124.00	$17,472.00	$15,860.00
Associates	2,500.00	2,644.00	2,884.00
Total	$19,624.00	$20,116.00	$18,744.00
Bulletin			
Subscriptions	$ 3,339.13	$ 3,414.83	$ 3,554.04
Advertising	2,689.55	2,524.90	4,628.46
Total	$ 6,028.68	$ 5,939.73	$ 8,182.50
Back Numbers, etc.			
Bound Volumes	$ 1,711.70	$ 1,677.24	$ 2,249.76
Back Numbers	485.02	391.44	738.14
Other Publications	59.40	21.69	23.50
*	—	—	14.50
	$ 2,256.12	$ 2,090.37	$ 3,025.90
Special Publications			
Continental Drift*	$ 159.85	$ —	$ —
Structure Volume *I**	260.26	411.28	549.26
Structure Volume *II*	315.93	425.88	629.71
Geology California*	3,555.73	946.35	682.15
Problems of Petroleum Geology	—	5,181.26	1,917.21
Geology of Natural Gas*	—	—	4,353.40
Total	$ 4,291.77	$ 6,964.77	$ 8,131.73
Other Income			
Convention Receipts	$ 9.96	$ —	$ 70.50
Delinquent Dues Charged Off	—	2,509.68	2,820.00
Interest	1,512.87	1,579.83	1,504.71
[1]	61.78	61.02	61.79
*	634.27	572.19	719.65
Miscellaneous	43.27	82.39	138.96
*	—	5.29	7.50
Total	$34,462.72	$39,921.27	$43,407.24

* Income of Publication Fund.
[1] Income of Research Fund.

TABLE V

COMPARISON OF ACCRUED EXPENSES BY YEARS

	1933	1934	1935
General and Administrative Expenses			
Salaries—Manager	$ 1,929.19	$ 1,670.83	$ 2,081.32
Clerical	4,717.67	4,800.29	5,541.48
Rent	300.00	325.00	600.00
Telephone and Telegraph	255.99	297.78	361.84
Postage	941.37	991.53	1,389.90
Office Supplies and Expenses	220.68	389.61	476.16
Printing and Stationery	365.04	147.57	388.43
Executive Expense	192.53	—	151.69
Audit Expense	350.00	450.00	300.00
Insurance and Taxes	124.77	92.50	155.28
Convention Expense	22.15	94.39	—
Freight and Express	5.65	48.00	104.99
Exchange and Refunds	22.18	17.13	—
Bad Debts	665.50	—	43.40

TABLE V (*Continued*)

	1933	*1934*	*1935*
Donations—Society Econ. Pal. & Min.	348.00	354.00	530.00
Society Petroleum Geophysicists	—	—	250.00
National Research Council	—	—	250.00
Research Committee Expense	—	—	57.60
Miscellaneous	5.23	69.23	26.73
Depreciation, Furn. and Fixtures	329.43	333.37	384.86
Total	$10,795.38	$10,081.23	$13,093.68
Publication Expenses			
Salaries—Manager	$ 2,545.24	$ 2,500.00	$ 2,500.00
Editorial	3,533.60	3,281.20	3,414.40
Printing Bulletin	7,773.95	8,589.11	10,468.02
Engravings	1,195.05	1,454.43	1,965.41
Separates	198.05	276.92	394.66
Stencils and Mailing	133.72	138.20	146.30
Binding Bulletins	406.30	504.35	362.69
Postage & Express (Bulletins)	533.05	714.57	762.56
Copyright Fees	24.00	24.00	24.00
Freight & Express		606.48	311.30
Discounts	49.99	56.15	63.85
Purchase of Back Numbers	17.50	3.50	250.40
Bad Debts	15.05		40.50
Miscellaneous	1.85	26.91	32.31
Special Publications	2,571.06	6,270.01	9,774.99
Total	$18,998.41	$24,445.83	$30,511.39
Total Expense	$29,793.79	$34,527.06	$43,605.07

TABLE VI

COMPARISON OF NET INCOME BY YEARS

	1933	*1934*	*1935*
Accrued Income	$34,462.72	$39,921.27	$43,407.24
Expenses:			
General and Administrative	10,795.38	10,081.23	13,093.68
Publication	18,998.41	24,445.83	30,511.39
Total	$29,793.79	$34,527.06	$43,605.07
Excess Income over Expenses	$ 4,668.43	$ 5,394.21	$ —197.83
Appreciation of Investments	707.65	4,776.06	2,507.31
Inventory Publications	—1,900.00	2,948.84	3,381.25
Net Accrued Income after Depreciation—Audits	3,476.58	13,119.11	5,690.73
Distribution—			
General Fund	—439.62	10,659.14	3,012.95
Publication Fund	3,581.92	2,331.45	2,466.09
Research Fund	334.28	128.52	211.69

TABLE VII

INVESTMENTS

1933 Values	*Cost*	*Market Value End of Year*	*Depreciation*	*Per Cent Depreciation*
General Fund	$35,040.70	$25,868.40	$ 9,172.30	26.2
Life Membership Fund	629.44	604.44	25.00	3.9
Publication Fund	14,246.61	10,094.81	4,151.80	29.1
Research Fund	1,351.73	1,056.73	295.00	21.8
Total	$51,268.48	$37,624.38	$13,644.10	26.6

TABLE VII (*Continued*)

	Cost	Market Value End of Year	Depreciation	Per Cent Depreciation
1934 Values				
General Fund	$39,259.78	$34,340.73	$ 5,517.32	14.05
Publication Fund	16,374.91	13,517.77	3,123.24	19.07
Research Fund	1,412.55	1,185.05	227.50	16.10
Total	$57,047.24	$49,043.55	$ 8,868.04	15.54
1935 Values				
General Fund	$26,531.33	$25,423.50	$1,107.83	4.17
Publication Fund	14,435.02	12,568.47	1,866.55	13.00
Research Fund	1,416.72	1,396.72	20.00	1.00
Total	$42,383.07	$39,388.69	$ 2,994.38	7.06

TABLE VIII

COMPARISON OF COST OF BULLETIN

	1933	*1934*	*1935*
Total Expenses*	$16,974.87	$18,213.19	$19,707.66
Monthly Edition	2,918-2,412	2,845-2,700	3,000
Total Copies Printed	31,068	33,096	35,951
Total Pages Printed Including Covers	1,842	2,024	2,236
Total Pages of Text	1,568	1,737	1,868
Total Cost per Copy	0.55	0.55	0.55

* Includes proportion clerical administrative expenses.

TABLE IX

SPECIAL PUBLICATIONS

	Structure Vol. I	Structure Vol. II	Geology California	Problems Petrol. Geology	Geology Natural Gas	Total
Inventory 12-31-34	$669.31	$2,181.60	$589.63	$2,781.85	$	$6,222.39
Inventory 12-31-35	375.39	1,789.20	314.35	1,672.65	5,562.60	9,714.19
Sales 1935	549.26	629.71	682.15	1,917.21	4,353.40	8,131.73
Total Edition	2,500	2,500	1,500	2,034	2,500	
Copies on hand 12-31-1934	230	606	332	943	—	
Copies on hand 12-31-35	129	497	177	567	1,534	
Number of Pages	510	780	355	1,073	1,227	
Cost (Inventory)	$2.91	$3.60	$1.78	$2.95	$3.90	
Selling Price When Issued	4.00	4.00	4.00	5.00	4.50	
Present Selling Price Members & Associates	5.00	5.00	5.00	5.00	4.50	
Non-Members	7.00	7.00	5.00	6.00	6.00	

TABLE X

BUDGET, 1936

	1935	*1936 Estimate*
Revenues		
Dues	$18,744	$20,000
Bulletin		
Subscriptions	3,554	3,650
Advertising	4,628	4,625
Bound Volumes	2,250	2,500
Back Numbers	738	750
Special Publications		
Structure Vol. I	549	400
Structure Vol. II	630	500
Geology of California	682	400
Problems of Petroleum Geology	1,917	1,000
Geology of Natural Gas	4,353	2,500
Geology of Tampico Region		1,750
Other Income		
Delinquent Dues Charged Off	2,820	1,500
Interest	2,286	2,000
Miscellaneous	184	100
Total	$43,407	$41,575
Expenses		
General and Administrative	13,094	15,000
Refunds on Bulletins 1933–1934		350
Publication Expense (General)	30,511	22,000
Geology of Tampico Region		3,100
Total	$43,605	$40,450
Surplus		$ 1,125

EXHIBIT III. REPORT OF EDITOR

Statistical information concerning the *Bulletin* for 1935 is submitted herewith. It may be noted that the total numbers of pages was 2,188, or an average of 182 pages per month, which is the largest annual *Bulletin* so far published by the Association.

In spite of this record, the need for papers for several issues was acute. At times we were some weeks behind our regular schedule in getting the manuscripts to the printers, and many manuscripts even then could not be sent through the regular procedure of editing and criticism which is believed advisable.

At present, the situation in regard to available material is somewhat better than it has been at the corresponding time for several years past but the Editorial staff must have the coöperation of the entire Association if the *Bulletin* is to be kept to the size and standard which our members and our financial resources justify.

The volume, *Geology of Natural Gas*, was published during the year and has been received very favorably. More than 1,000 copies have been sold and sales are continuing satisfactorily. Practically the entire edition (2,500 copies) of this volume must be sold to reimburse the Association for its cost, since the price set on it is very little more than the actual cost per copy of printing the edition.

The *Gulf Coast Oil Fields* and *Geology of the Tampico Region, Mexico,* have been delayed somewhat beyond our expectations, but it is hoped that both volumes will be issued during 1936.

PAGES IN BULLETIN, 1935

Total number of pages of majors	1,436
Total number of pages of minors	432
Total number pages of majors and minors	1,868
Total number of Roman pages	320
Total number of pages in 1935	2,188
Total number of illustrations	423
Total number of major articles	66
Total number of minor articles*	61
Estimated number of pages of illustrations	288

* Minor Articles: Geological notes, Discussions, Reviews, Memorials.

1935 BULLETIN

Month	*Pp. Majors*	*Pp. Minors*	*Pp. Maj. and Min.*	*Roman*	*Total Pp.*
January	115	37	152	32	184
February	140	24	164	20	184
March	95	57	152	28	180
April	91	29	120	24	144
May	107	73	180	24	204
June	134	34	168	24	192
July	124	28	152	28	180
August	137	27	164	24	188
September	136	16	152	24	176
October	139	25	164	28	192
November	124	32	156	24	180
December	94	50	144	40	184
Total	1,436	432	1,868	320	2,188
Monthly average	119.6	36	155.6	26.6	182.3

1935 BULLETIN ILLUSTRATIONS

Month	*No. of Illustrations*	*Est. Pp. Illustrations (Full Page Space)*
January	33	18½
February	55	24
March	36	29
April	13	11½
May	36	17½
June	23	20
July	38	29½
August	42	32
September	30	21
October	54	28¼
November	41	37½
December	22	19½
Total	423	288¼
Monthly average	35.2	24.2

EXHIBIT IV. REPORT (MINUTES) OF GENERAL BUSINESS COMMITTEE

The meeting was called to order by H. W. Hoots, vice-chairman, at 2:00 P.M., March 18, 1936, at the Mayo Hotel, Tulsa, Oklahoma.

The following members were present.

Executive committee: A. I. Levorsen, E. C. Moncrief, W. B. Heroy, L. C. Snider

Members-at-large: Ralph D. Reed, Merle C. Israelsky, A. M. Lloyd, Ed. W. Owen, John L. Rich
Division of Paleontology: Gayle Scott, Maynard P. White
Division of Geophysics: F. M. Kannenstine, L. W. Blau represented by E. E. Rosaire, B. B. Weatherby
District representatives:

Amarillo, J. D. Thompson represented by John E. Galley
Appalachian, James G. Montgomery, Jr.
Canada, not represented
Capital, Arthur A. Baker
Dallas, not represented
East Oklahoma, L. Murray Neumann, Ira H. Cram, E. F. Shea
Fort Worth, not represented
Great Lakes, Frank W. DeWolf
Houston, J. M. Vetter represented by J. Brian Eby
Mexico, William A. Baker
New Mexico, Neil H. Wills
New York, not represented
Pacific Coast, E. F. Davis, Roy M. Barnes, Louis N. Waterfall represented by Earl B. Noble
Rocky Mountains, C. E. Dobbin
San Antonio, Thornton Davis
Shreveport, G. W. Schneider
South America, not represented
So. Permian Basin, Robert L. Cannon
Tyler, not represented
West Oklahoma, Gerald C. Maddox
Wichita, not represented
Wichita Falls, R. A. Birk

1. *Minutes of previous meeting.*—It was moved, seconded, and carried that the reading of the minutes of the last meeting of the committee be omitted, as the minutes had been published in the *Bulletin.*

The reports of the following committees were read.

2. *Report of the committee on geological names and correlations,* Ira H. Cram, chairman.

3. *Report of the research committee,* Donald C. Barton, chairman.

4. *Report of committee on applications of geology,* Frank R. Clark, chairman.

5. *Report of representative of Association on Division of Geology and Geography, National Research Council,* Donald C. Barton, unofficially acting as representative.

After the reading of the reports it was moved, seconded, and carried that the reports be accepted and referred to the general business meeting with the recommendation that they be not read but that they be published in the May, 1936, *Bulletin.*

The following resolutions were moved, seconded, and adopted.

6. *Ardmore Geological Society.*—That the application of the Ardmore Geological Society to become affiliated with the Association be approved and recommended to the annual business meeting.

7. *Midland Geological Society.*—That the application of the Midland Geological Society for dissolution from the Association be approved and referred to the annual business meeting.

8. *Change of By-Laws as to life membership.*—That the recommendation of the executive committee be approved and submitted to vote of the membership at the annual business meeting, changing the first sentence of Article I, Section 2, of the By-Laws to read as follows.

On payment of two hundred dollars ($200.) any member in good standing shall be declared a life member and thereafter shall not be required to pay annual dues.

9. *Change of name of the Association.*—That no action be taken on the proposal of Arthur Wade that the word "American" be left off the title "The American Association of Petroleum Geologists."

The meeting adjourned at 3:40 P.M.

H. W. Hoots, *chairman* E. C. Moncrief, *secretary*

Exhibit V. Report of Committee on Geologic Names and Correlations

During the past year the committee studied and made recommendations upon the following papers.

Ross Maxwell, The Hunton "Formation" of the Arbuckle Mountains of Oklahoma
Fanny Carter Edson, Résumé of St. Peter Stratigraphy
James H. Gardner, Talihina Chert Section at Atoka, Oklahoma
Edward A. Koester, Geology of Central Kansas Uplift
Charles W. Wilson, Jr., E. L. Spain, Jr., Age of Mississippian "Ridgetop Shale" of Central Tennessee
C. H. Dane, T. A. Hendricks, Correlation of Bluejacket Sandstone

The committee published in the January, 1936, *Bulletin* a note listing various publications to be consulted on problems of nomenclature. The note was accompanied by a request that members interested in precise structural nomenclature send to the committee their ideas on the proper usage of the terms "structure," "high," and "low." Max L. Krueger, the only Association member replying to this request submitted the following.

It seems to me that "structure" is a general term. The structure in a locality can apply to a monocline, anticline, syncline or any number of folded structural forms. When referring to a known oil field, it should be qualified to "oil structure." Likewise, when referring to a locality which has a folded contour suggesting a good trap for oil, it should be termed a "possible" or "probable" oil structure.

The word "high" should represent the structural relationship of an area to contiguous areas and it should usually be qualified by the word "structurally"; the reverse of this should define the word "low" in structural relationships.

I would like to add another word which is badly misused, as a structural term, on the West Coast. This is the word "closure." "North closure" of an anticline is spoken of when actually "north plunge" of the anticlinal crest is the correct terminology. "Closure," as I understand it, is a term which is described in feet and represents the difference between the highest structural point, on a dome or anticline, and the highest point at which oil or gas would *not* be trapped. I am assuming, of course, the generally accepted theory of up-dip migration for oil and gas.

The committee compliments H. W. Straley, III, for his work on structural nomenclature published in the *Journal of Geology*, Volume XLII, Number 7, 1934, and the *Pan-American Geologist*, Volume XLIV, 1935.

The committee has as yet devised no way of preparing a Glossary of

Structural Terms Used in Petroleum Geology. Three members of the Association capable of organizing and editing such a volume do not have the time to undertake the task. Doubtless a glossary of the type proposed would have a certain value, but until a group of geologists interested in this kind of academic work are found, the problem of preparing the glossary will remain unsolved. Frank Hess of the Bureau of Mines is working on a revision of the glossary the Bureau published in 1920. He has not completed half of the necessary work and suggests that some kind of a coöperative plan might be worked out.

It is well known that there are many problems of stratigraphic nomenclature. John Bartram suggests that the committee can render considerable aid to geologists by clarifying, whenever possible, these problems. Possibly the committee can publish a series of geologic notes on the preferred nomenclature of the various areas.

IRA H. CRAM, *chairman*

EXHIBIT VI. REPORT OF CHAIRMAN OF RESEARCH COMMITTEE

The annual dinner and round table discussion of the research committee were held as usual at Wichita on the Wednesday evening preceding the opening of the annual meeting of the Association. Both the dinner and the round table were well attended. The key subject of the round table discussion was "Cases of Migration of Petroleum." Several of the discussions have been amplified to brief papers and have been published, or are to be published. Digests of the discussion, solicited by the chairman from the geologists who spoke, will be published in the department of Research Notes in the May *Bulletin*.

No mid-year meeting of the committee was held this year on account of the mid-year meeting of the San Antonio Geologic Society at Mexico City.

Professor Plummer has worked over the replies to the inquiry in the Census of Research in the Association, and is submitting a special report.

The study group at Houston, for whose organization members of the committee (largely Mr. Levorsen) were responsible, has had regular evening meetings through the year, with an attendance of from fifteen to thirty persons. Various papers or groups of papers have been chosen, rather commonly from the gas volume, or from Schuchert's recent book on *Historical Geology of the Antillean-Caribbean Region*. A review of the papers is given by some member of the group and serves as a starting point for discussion by the group as a whole. The chairman would like to recommend such discussion groups to the geologists of other centers.

A committee on the variation of the oils in Oklahoma with Murray Neumann as chairman was appointed by the Geological Society of Tulsa at the instigation of the research committee. In coöperation with the U. S. Bureau of Mines Experiment Station, particularly Harold M. Smith of the Station, the committee made an interesting study of the oils at Oklahoma City, Seminole and other fields.

As a result of the discussions at last year's round table meeting, John G. Bartram and C. E. Dobbin made an interesting study of the stratigraphic variation of oil in the Rocky Mountain district.

The research activities of the several members of the committee briefly have been as follows, according to their reports to the chairman.

M. G. Cheney: A paper, "Economic Spacing of Oil Wells," was completed. Further progress was made in defining the geological history of the Concho arch and the Bend flexure areas. The isopach maps of East Texas are nearing completion, but his research activities during the past year seem to him rather small.

Robert H. Dott: As chairman of the subcommittee on cross sections in the Oklahoma-Kansas area, he endeavored to stimulate a little interest in the preparation of new sections, or the revision of old ones, but found everyone too busy with private and company affairs. Several geologists promised to go ahead with sections which they promised several years ago, but no one has redeemed his promise. A few orders for copies of the existing sections have come in during the year. Now he is out of touch with the men who would be willing and able to carry on this cross-section work and suggests that some one else be appointed to take over the work. The tracings of the sections have been turned over to J. P. D. Hull; the negatives and photographic reductions are on file at the Tulsa Camera Record Company.

K. C. Heald: He has been active in promoting research and experimental attack on various problems which are more closely allied to petroleum technology than to geology; and has helped to promote some work in the field of sedimentation, using specific instances for the study of depositional history, origin and characteristics, both locally and regionally, both of formations and of members of formations. He has also maintained contact with work in progress on the study of limestones and in particular on the history of their formation and of the development of their porosity. That is an old A.P.I. project which had to be abandoned because of scarcity of funds. It is believed by Heath to be an extremely important project which should be encouraged. He has maintained contact with the activities of the National Research committee, particularly with A. C. Lane's committee on the measurement of geologic time.

R. S. Knappen: His personal research activities have been confined largely to the problem of the disposal of salt water in Kansas and Oklahoma, in the main in connection with the problem of finding ways and means of putting the water underground where it will do no damage. The problem is chiefly chemical, involving (a) the reactions of oilfield brines with the water existing below the surface, and (b) reactions resulting from contact of these brines with air during their period of exposure at the surface.

R. C. Moore: In collaboration with a selected group of members of the Association, he has continued the study of the Permian and Pennsylvanian stratigraphy of the northern Mid-Continent region; his particular field of attention was the broad regional relationship of these rocks with reference to the times of structural deformation. During the summer of 1935 he spent several weeks studying classic exposures of Carboniferous beds in western Europe and attended a several-day meeting of the Congress of Carboniferous Stratigraphy in Heerlen, Holland.

F. B. Plummer: A monographic report on the Permian and Pennsylvanian ammonoids of the Mid-Continent was made under support of the Penrose fund of the Geological Society of America. Investigations of the radial flow in oil sands were made and have led to three papers.

Henry Ley: The rush of company work has precluded accomplishment of much research.

Parker D. Trask: His entire time during the past year has been devoted to the study of source beds. K. C. Heald writes that Trask's project is progressing satisfactorily, that certain new avenues of attack have been opened and that he and Trask feel more strongly than ever the high importance of the continuation of this fundamental research.

Donald C. Barton: His studies of the geology of the variation of petroleum have been centered during the year largely on the problem of some invariant characteristic by which oils of identical origin may be recognized. Interesting results are being obtained. He has also been acting as co-editor with George Sawtelle on the symposium, *Gulf Coast Oil Fields*.

The Division of Geology, National Research Council, is much interested in the work of this committee. The annual report of the chairman of this committee for several years has been treated as if it were the report of a chairman of one of the Division's committees, and has been printed in the annual report of the Division among the reports of the respective chairmen of the Division committees. The chairman of this committee as delegate from the Geological Society of America to the National Research Council affords unofficial liaison between this committee and the Division of Geology of the National Research Council.

The following supplementary report was presented at the meeting of the general business committee.

The report of the chairman has been submitted to the president, and appended to that report is a report by Professor Plummer on the canvass of research work in the Association.

The committee expresses the opinion that Professor Plummer's report should be made available to those who may be interested in it, that perhaps a paragraph about the report should be run in the *Bulletin* under the heading of Research Committee Notes and that the report be obtainable upon request to Association headquarters.

The opinion was also expressed by the committee that in order to encourage the younger men, all men who wish to present papers at the annual meeting should be encouraged to do so, with of course certain limitation against unworthy papers and that lengthy programs should be relieved by subdivision of the groups in which the papers are presented rather than by the rejection of papers.

Donald C. Barton

Exhibit VII. Report of Committee on Applications of Geology

This report outlines the activities of the members of the committee on applications of geology for the year 1935–1936. The two previous annual reports of this committee may be found in the May *Bulletins* for the years 1934, pages 708–11, and 1935, pages 747–50.

The work of the present committee shows continued progress in the field of applied geology in its relation to the general public welfare and in general educational circles. The results of the various members in humanizing geology depends on the circumstances surrounding their everyday official duties and the interest taken by committee members.

A definite movement has been initiated, coördinating the efforts of the state surveys, the Geological Society of America, and the American Association of Petroleum Geologists, to more widely popularize and publicize geology.

This movement took definite form at the Geological Society of America's meeting, December, 1934, at which time a committee was appointed, consisting of Carey Croneis, chairman, George C. Branner, W. O. Hotchkiss and A. K. Lobeck. The chairman was also authorized to select a fifth member from the Washington group of geologists and he appointed Francois Matthes. Still later, the chairman suggested that an attempt be made to unify the program of all geological societies in publicizing geology. Accordingly, the chairman of the committee on applications of geology for the American Association of Petroleum Geologists was appointed a member of the Geological Society of America's committee.

Croneis is also a member of the Association's committee on applications of geology, and therefore, reference is here given to his report to the Council of the Geological Society of America, December 26, 1935. It is urged that future members of the Association's committee secure a copy of Croneis' report for study and guidance in the future work of this committee.

The Croneis Committee

> strongly urges that the council take steps to select a man to take active charge of publicizing geology in North America. . . . The man selected for this key position should be a man of pleasing personality, a good speaker, an accomplished writer, an able organizer and he should be a trained geologist. . . . At a recent meeting of the Travel and Industrial Development Association of Great Britain and Ireland, no less a person than Edward of Wales recited a key note jingle:
>
> He who whispers down a well
> About the goods he has to sell,
> Will never reap the golden dollars
> Like he who shows them round and hollers.
>
> This is true of science as well as merchandising.

Croneis includes an excerpt from an article by Glenn Frank, which states that future social progress depends on three men—the investigator, the interpreter and the administrator. We never lack the administrator nor the investigator, but we do lack the interpreter who effectively plays as mediator between the specialist and the layman.

Croneis believes that the best place to popularize geology is on the ground itself. One of the most powerful factors in public understanding of geology would be the labeling of roadside exposures and sites. Some of the pioneering efforts toward labeling geology have had splendid public reaction and it is to be hoped that the movement will become nation-wide.

Croneis states that geologists are not united and that unity of effort is one of the first requisites for any publicity program.

The Croneis committee received hearty coöperation from such sources as *Science Service*, the National Park Service, Ward's Natural Science Establishment in Rochester, the Department of Geology at Rochester University, University Broadcasting Council of Chicago, and many others including many of the better and more popular magazines. It seems, therefore, that the most necessary thing at the present time is to find the proper "interpreter" of geological facts to give to the "administrators" and the laymen, the ideas of the "investigators." The Council of the Geological Society of America has taken no definite action on the Croneis report or recommendations.

Croneis coöperated with the National Park Service in the preparation of a new series of six geological sound films of the educational type. These pictures have been widely circulated and have met with popular favor.

Work of the National Park Service under the direction of Earl A. Trager, chief naturalist, and one of our members is so effective in publicizing geology that a short discussion of the work is here appropriate.

The Park Service is conducting lectures to tourists at the various parks each season for the purpose of acquainting the public with the geological processes that have created the varied landscapes. The National Parks were selected not only for their scenic beauty, but for the geology they possess. These lectures are effective in presenting the geologic story to the layman, because the best place to teach geology is on the ground.

The Park Service is rapidly increasing its new picture series of the parks and at present is engaged in taking technicolor movies in the parks, which will be shown throughout the country. The past year, the Park Service, in coöperation with the University of Chicago and the Erpi Picture Consultants, completed six sound motion picture films illustrating some geologic processes. The titles of the films are: "The Work of Rivers," "Ground Water," "Work of Atmosphere," "Geologic Work of Ice," "Mountain Building" and "Volcanoes in Action." These pictures, by means of reprints, are receiving wide circulation both in schools and before the public. These pictures were shown at the annual meeting in Tulsa on March 20th, 1936.

The Humble Oil and Refining Company will present an exhibit at the Texas Centennial Exposition at Dallas this year. It is to be half geological and will comprise the following.

- A. Three paleogeographic maps of Texas and adjacent portions of Mexico, Oklahoma and New Mexico
  1. Map showing general conditions in Mid-Pennsylvanian time
  2. Map showing general conditions in Woodbine time
  3. Map showing general conditions in Midway time
- B. A relief areal geologic map of Texas and adjacent portions of Mexico, Oklahoma and New Mexico
- C. A relief structural geologic map of the same areas
  (All the above five maps are presented on a scale of 1 inch to 500,000 feet horizontally, and the relief maps are on a 1 inch to 1,000 feet vertical scale.)
- D. A presentation of four diorama cross sections of the following oil fields
  1. Spindletop
  2. East Texas
  3. Powell
  4. Big Lake (West Texas)
  (These cross sections will be drawn on a horizontal and vertical scale of 1 inch to 250 feet.)

After the close of the exposition, this exhibit is to be deposited in the Memorial Museum at Austin.

The information concerning this exhibit was furnished by Donald Barton.

Marvin Lee, our committee member in Kansas, writes that he has been coöperating with the Kansas nomenclature committee and also worked on details of the correct naming of oil fields and classification of the common sources of supply. His work with the State Corporation Commission in which he acts as technical adviser has helped further the public's appreciation of geology.

From Denver comes the report from A. E. Brainerd that they have been doing constructive work in bringing geology into the schools through lectures and also have been trying for some time to secure the teaching of elementary geology in the high schools of Denver, or at least to succeed in obtaining geological courses as electives.

In San Antonio, Herschel H. Cooper reports that their library museum is growing and many important additions have been made in the past year. Mrs. Henke, who is in charge of the Museum has been supervising the display of cross sections and other diagrammatic information, which has been contributed by the local geologists. The San Antonio Geological Society has also endeavored to hold open house to the public once or twice a year, devoting the time to some popular and non-technical geological subject. Talks have also been given at the various civic organizations in order to enlighten the general public on the useful applications of the principles of geology. The San Antonio section is also coöperating with E. H. Sellards, of the Department of Economic Geology, who is in charge of the disbursements of the Public Works Administration funds provided for geological investigation.

S. E. Slipper of the Alberta Province writes that he and others have given elementary lectures on petroleum and natural gas geology before Service Clubs during the past year. The Canadian Western Natural Gas, Light, Heat and Power Co., Ltd., by whom Slipper is employed, has begun a school of instruction on various subjects connected with natural gas and in this course he gave papers on the subject of "Natural Gas Geology."

E. K. Soper of the University of California was instrumental in supplying and installing geological exhibits of well cores, fossils, structural geology and models at the University of California, the Los Angeles Museum and the Los Angeles Planetarium in Griffith Park. Also through his efforts, geological courses, which were introduced in the schools of Los Angeles, are being continued.

In order properly to present the numerous activities of H. S. McQueen, assistant State Geologist of Missouri, portions of his report to the chairman of the committee are here quoted.

> As a result of an epidemic of typhoid fever, which menaced a thriving town in the southeast part of the state, a geological examination was made and indicated that the course of contamination was the water supply, which was obtained from a deep well. Suggestions were made to alleviate the trouble and since that time there has been no recurrence of the disease.
>
> As a result of this incident, discussions were held between the engineers of the State Board of Health and geologists of this department, which finally led to the adoption of specifications for the drilling of water wells for public supplies. In these specifications, which have had wide distribution and which are familiar to consulting engineers, drilling contractors and others, it is required that well samples be saved during the course of the drilling and that they be submitted to the State Geological Survey, first in order to determine the point at which casing is to be set, and second, in order to determine the total depth of the well.
>
> The problem of obtaining water for public use is distinctly within the field of applied geology. At the inception of the Civilian Conservation Corps camps, officers of the United States Army, who were charged with the duty of water supplies, contacted the Missouri Survey with regard to the possibilities of obtaining water supplies in a limited number of localities. In order to properly advise them, geologists were assigned to the work and personally examined each site—accepted some and rejected others. As the program developed, it became quite apparent that it would be advisable to prepare formal reports covering each site accepted and this was done. All geological features, as they affected the ground water possibilities, drilling conditions, pumping conditions and other phases were taken into consideration.
>
> During the year 1935, the largest number of Civilian Conservation Corps camps were established and at least one well was drilled at each camp. The earlier success of this department in handling such matters resulted in the officers of the Army turning over the complete program to us. As a result, the drilling of the wells, even though attended at times with numerous problems, was completed to the satisfaction of all concerned. It is interesting to note that the officers assigned to this work were wholly

unfamiliar with ground water problems and lacked specific knowledge regarding the many problems attendant thereto, particularly in the Ozark region of southern Missouri.

The contracts of the wells drilled during the year mentioned carried a clause to the effect that unless a full and complete set of samples and a certified copy of the driller's log were furnished this office, the money therefor, would not be paid to the contractor. This clause imposed no hardship upon the contractor, and in fact, he felt that he had been relieved of certain responsibilities in connection with the successful completion of any particular well, and that any grief connected therewith could be handled by this department.

This work resulted in the commendation of the District Commander, United States Army, and in addition has provided adequate and potable supplies of water to the Civilian Conservation Corps camps. It also resulted in solidifying contacts between this office and the drilling fraternity and brought to the attention of the public the need for geological work in connection with similar problems.

During the year 1935, similar work has also been done in cities and towns and for the Public Works Administration in connection with the construction of water supplies. As a result of those contacts, I can safely say that this office is called upon more than ever before for specific information relating to an area.

We have also prepared and have available for distribution to high schools, a small collection of the important rocks and minerals found in this state. We also disseminate annually to the schools of Missouri information regarding the mineral resources.

Since the latter part of 1933, we have sponsored certain federal reemployment projects which have resulted not only in the employment of engineers, geologists, and professional and technical people, but also in the compiling and obtaining of much new data that will be of increasing value in the future. That particular work has, in my mind, also acquainted the people of the state with our work and in many instances has, I believe, given them a better conception of the science of geology.

The foregoing is a fairly complete outline of the activities of the committee during the past year. I am sorry to report that little or no activity was carried on by the members of the committee in several districts; however, the activities by some members seem to make up in part for the lack of results in other quarters.

The chairman cannot criticize any member for lack of results, since he has little or northing to report of a specific nature in the Tulsa district.

Through the efforts of president A. I. Levorsen, the First National Bank and Trust Company of Tulsa sponsored a 15-minute broadcast over KVOO, Sunday, March 15, 1936, outlining the importance of geology to the oil industry. The broadcast included a brief history of the organization and activities of the Association and mentioned in some detail the arrangements for the twenty-first annual meeting to be held in Tulsa, the week of March 18 to 21, 1936.

Moving pictures and the radio are excellent media through which the story of geology may be carried most effectively to the general public. It is hoped that these media of communication will be used extensively in the future.

FRANK R. CLARK, *chairman*

EXHIBIT VIII. REPORT OF REPRESENTATIVE TO NATIONAL RESEARCH COUNCIL

In partial conformity with telegraphic request from the president of the Association, I unofficially looked after the interests of the Association at the annual meeting of the Division of Geology and Geography of the National Research Council, April 27, 1935, at Washington, D.C., in place of R. S. Knappen, who had resigned a few days before the meeting; but as representa-

tive to the Council from another society, I could not officially accept the nomination to act as representative of the Association at that meeting; but as all voting was rather routinely unanimous and as there was no prohibition against my airing the viewpoints of the Association on any pertinent questions, the lack of official representation of the Association at the meeting doubtfully was serious.

The Division held a morning and an afternoon meeting. It passed resolutions on the deaths of David White and of other former members of the Division or its committees, spent most of its time in listening to the reports of its research committees, elected the following officers (chairman E. S. Bastin holds office for a 3-year term): vice-chairman, W. L. G. Joerg; executive committee, E. S. Bastin, chairman, W. L. G. Joerg, vice-chairman, A. F. Buddington, Charles Butt, W. F. Foshag, Robert S. Platt. It elected representatives to the Advisory Council of the U. S. Board of Surveys and Maps, Advisory Council of the American Association of Water Well Drillers, committee on the classification of coal of the American Society for Testing Materials. It accepted the nomination of F. H. Lahee as delegate from the American Association of Petroleum Geologists.

The purpose of the National Research Council seems to be: (a) to act as a national coördinating center for the promotion of research, (b) upon request to act in advisory capacity to departments of the government, (c) to nominate delegates to advisory boards to other associations or to departments of the government, and to oversee the allocation of research fellowships and grants-in-aid.

Most of the detailed work of the association is handled by semi-autonomous divisions, of which the Division of Geology and Geography is one. Each delegate is assigned to the division of the branch of science to which his science belongs and does his work with that division. Most of the detailed work of the division of Geology and Geography is done through its research committees. The American Geophysical Union, which was sponsored by the National Research Council and which still maintains some connection with that Council, functions like a division of the Council in fostering research in seismology, meteorology, geodesy, hydrology, terrestrial magnetism, and vulcanology.

The committees of the Division are: executive committee, advisory committee of past chairman of the division, International Geographical Unions national committee of the United States, committees respectively on fellowships, Pan-American Institute of Geography and History, accessory minerals of crystalline rocks, aerial photographs, batholithic problems, *Bibliography of Economic Geology*, conservation of the scientific results of drilling, cooperation with the Bureau of the Census, land classification, measurement of geologic time, micropaleontology, paleobotany, paleoecology, petrotectonics, processes of ore deposition, sedimentation, State geological surveys, stratigraphy, studies in petroleum geology, and tectonics.

Many of the committees of the Division are decidedly active and have been very successful in promoting coöperative research. The results of the work of the committee on sedimentation is known to many members of the Association through its publications on sedimentation. The *Bibliography of Economic Geology* is sponsored by the Division of Geology and is under the direction of one of the committees. The committee on studies in petroleum geology is not very active. Two committees are undertaking projects of much

interest to the members of this Association. The committee on stratigraphy is undertaking the two important projects: (a) the preparation of a series of correlation charts showing at once the present classification of the strata in each province of exposure and the correlation of the many stratigraphic units now recognized; and (b) the preparation of a series of handbooks on stratigraphy, one for each system. The committee on tectonics is attempting to construct a tectonic map of the United States.

The annual meeting of the Division in largest part consists of the presentation of the reports of the chairmen of the various committees and thereby takes on the aspect of the meeting of a geological and geographical society.

The Division is much interested in the research which is carried on by this Association, and has the report of the chairman of the research committee of this Association presented with the reports of the chairmen of the committees of the Division.

The liaison between the Association and the Division is not so close as it should be. The division comprises two representatives each from the Geological Society of America and Association of American Geographers, and one representative each from the Mineralogical Society of America, Paleontological Society, American Geographical Society, Society of Economic Geologists, and the American Association of Petroleum Geologists. The lack of close liaison is the effect of a slight taint of mutual provincialism. The Association belongs primarily to the Southwest and to California, whereas those other societies belong primarily to the Northeast, the Great Lakes states, and Washington. The interests of the Division therefore reflect the interests primarily of those other societies. Through lack of mutual acquaintance between the Division and members of the Association the ability of many members of the Association to contribute pertinently to the projects of the Division is not known to the latter, although of course many Association members, such as R. C. Moore, M. G. Cheney and E. H. Sellards, are serving importantly on several committees and sub-committees. The National Research Council is doing a valuable job in fostering and promoting individual and coöperative research. I would like to urge strongly the importance of representation of the Association in the councils of Division of Geology and Geography.

DONALD C. BARTON

EXHIBIT IX. REPORT OF RESOLUTIONS COMMITTEE

Be it resolved, that we, the members of The American Association of Petroleum Geologists, express our sincere thanks and appreciation first to the retiring officers of the Association for their able administration of Association affairs for the past year and second to those who have worked so faithfully for the success of the twenty-first annual meeting of the Association, particularly the following.

The Tulsa Geological Society and Frank R. Clark, W. B. Wilson and Ira H. Cram of the general committee appointed by that Society; and chairman and members of their several committees.

The City of Tulsa, the Tulsa Chamber of Commerce and Mayor T. A. Penney.

Mrs. R. S. Knappen, Mrs. L. Murray Neumann and all the ladies of their committee.

The Mayo Hotel, the Tulsa Hotel and the University Club of Tulsa for generously placing at our disposal rooms and other facilities for the conduction of our meetings.

The Associated Press and the United Press, the *Tulsa World* and *Tulsa*

Tribune, the *Daily Oklahoman* of Oklahoma City and the *Wichita Beacon* of Wichita, Kansas, and the oil trade journals for their efficient and careful report of our meetings.

All those who furnished transportation for the entertainment of the ladies.

The Tulsa Country Club for golf privileges and the Oakhurst Country Club for the ladies tea.

The ladies who furnished the music for the Oakhurst tea.

Miss Adah Robinson for her talk to the visiting ladies at the Boston Avenue Methodist Church which she designed.

Vandever's for furnishing favors for the ladies luncheon at the Tulsa Country Club.

Seidenbach's for furnishing the fashion show and music for the ladies luncheon at the Tulsa Country Club.

The many shops of Tulsa which made special displays and exhibits for the ladies.

Christ King Church for the educational and art exhibit.

The University of Tulsa for its Indian and Modern Art exhibitions.

The Laughlin-Simmons Well Elevation Service for cigars and cigarettes for the smoker.

Those who contributed prizes and green fees for the golf tournament.

Earl Trager of the National Parks Service for showing sound motion pictures illustrating geological processes.

The W. P. A. Symphony orchestra and George C. Baum, the director.

Be it resolved, that these resolutions be included in the minutes of the meeting and that copies be sent to the individuals and organizations named.

Whereas, it has come to the attention of the members of the Association that our former president, J. Y. Snyder, of Shreveport, Louisiana, is ill.

Be it resolved, that our secretary be instructed to convey to Mr. Snyder our sincere hopes for his speedy recovery and that a copy of this resolution be spread upon the minutes of this meeting.

MONROE CHENEY, *chairman* THERON WASSON CHESTER CASSEL

The chairman of the resolutions committee read the following letter addressed to The American Association of Petroleum Geologists.

Officers and members of the San Antonio Geological Society wish to express publicly before members of The American Association of Petroleum Geologists their sincere appreciation of the coöperation of the executive committee and managerial staff of the Association in connection with the annual meeting of the San Antonio Geological Society in Mexico City, October 16–20, 1935. We wish, especially, to thank president A. I. Levorsen for his timely suggestions, active interest and fine spirit of helpfulness throughout the period of preparation for the meeting, during the week of the meeting, and in connection with handling unfinished business after our return to the states. We believe that his contacts with officers and members of the Geological Institute of Mexico and with government officials have tended to perpetuate friendly relationships between members of our profession in Mexico and the United States.

Sincerely,

THE SAN ANTONIO GEOLOGICAL SOCIETY,
(Signed) JOSEPH M. DAWSON, *retiring president*

EXHIBIT X. REPORT OF BALLOT COMMITTEE

After counting the ballots we find the vote for vice-president was: Dobbin, 213; Newby, 102.

The other officers (Ralph D. Reed, president; Charles H. Row, secretary-treasurer; and L. C. Snider, editor) were uncontested.

JOHN T. BARTRAM, *chairman* HERSCHEL H. COOPER HAROLD W. HOOTS

ASSOCIATION COMMITTEES

EXECUTIVE COMMITTEE

Ralph D. Reed, *chairman*, Los Angeles, California
Chas. H. Row, *secretary*, San Antonio, Texas
A. I. Levorsen, Tulsa, Oklahoma
C. E. Dobbin, Denver, Colorado
L. C. Snider, New York, N. Y.

GENERAL BUSINESS COMMITTEE

Arthur A. Baker (1938)
R. F. Baker (1937)
William A. Baker (1937)
Roy M. Barnes (1937)
Robert L. Cannon (1937)
C. G. Carlson (1938)
Ira H. Cram (1937)
Thornton Davis (1937)
Frank W. DeWolf (1937)
C. E. Dobbin (1937)
J. Brian Eby (1938)
H. B. Fuqua (1937)
L. W. Henry (1937)
Harold W. Hoots (1938)
J. Harlan Johnson (1937)
James W. Kisling, Jr. (1937)
A. I. Levorsen (1937)
Theodore A. Link (1937)
Gerald C. Maddox (1937)
J. J. Maucini (1938)
James G. Montgomery, Jr. (1937)
Kenneth Dale Owen (1937)
Ralph D. Reed (1938)
R. E. Rettger (1938)
Chas H. Row (1937)
G. W. Schneider (1937)
Gayle Scott (1937)
E. F. Shea (1937)
L. C. Snider (1937)
Clare J. Stafford (1937)
J. D. Thompson, Jr. (1938)
Louis N. Waterfall (1937)
Gerald H. Westby (1937)
Maynard P. White (1937)
Neil H. Wills (1937)

RESEARCH COMMITTEE

Donald C. Barton (1936), *chairman*, Humble Oil and Refining Company, Houston, Texas
Harold W. Hoots (1936), *vice-chairman*, Union Oil Company, Los Angeles, California
M. G. Cheney (1937), *vice-chairman*, Coleman, Texas

R. S. Knappen (1936)
W. C. Spooner (1936)
Parker D. Trask (1936)
Robert H. Dott (1937)
K. C. Heald (1937)
F. H. Lahee (1937)
H. A. Ley (1937)
R. C. Moore (1937)
F. B. Plummer (1937)
John G. Bartram (1938)
C. E. Dobbin (1938)
Stanley C. Herold (1938)
Theodore A. Link (1938)
C. V. Millikan (1938)
John L. Rich (1938)
C. W. Tomlinson (1938)

REPRESENTATIVE ON DIVISION OF GEOLOGY AND GEOGRAPHY NATIONAL RESEARCH COUNCIL

Frederic H. Lahee (1937)

GEOLOGIC NAMES AND CORRELATIONS COMMITTEE

Ira H. Cram, *chairman*, Pure Oil Company, Tulsa, Oklahoma

John G. Bartram
M. G. Cheney
Alexander Deussen
B. F. Hake
G. D. Hanna
M. C. Israelsky
A. I. Levorsen
C. L. Moody
R. C. Moore
Ed. W. Owen
J. R. Reeves
Allen C. Tester
W. A. Thomas

TRUSTEES OF REVOLVING PUBLICATION FUND

Ralph D. Reed (1937)
Ben F. Blake (1938)

TRUSTEES OF RESEARCH FUND

G. C. Gester (1937)
A. A. Baker (1938)
Alex W. McCoy (1939)

FINANCE COMMITTEE

E. DeGolyer (1937)
Thomas S. Harrison (1938)
W. B. Heroy (1939)

COMMITTEE ON APPLICATIONS OF GEOLOGY

Frank Rinker Clark, *chairman*, Box 981, Tulsa, Oklahoma

William H. Atkinson
Arthur E. Brainerd
Hal P. Bybee
Herschel H. Cooper
Carey Croneis
H. B. Hill
Earl P. Hindes
Marvin Lee
S. E. Slipper
H. S. McQueen
E. K. Soper
J. M. Vetter

THE AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS

CONSTITUTION AND BY-LAWS

(Adopted 1918 and amended 1921, 1922, 1923, 1925, 1927, 1928, 1929, 1930, 1932, 1933, 1935, and 1936)

CONSTITUTION

ARTICLE I. NAME

This Association shall be called "The American Association of Petroleum Geologists," incorporated under the laws of Colorado the 21st day of April, 1924, for a period of twenty (20) years.

ARTICLE II. OBJECT

The object of this Association is to promote the science of geology, especially as it relates to petroleum and natural gas; to promote the technology of petroleum and natural gas and to encourage improvements in the methods of exploring for and exploiting these substances; to foster the spirit of scientific research amongst its members; to disseminate facts relating to the geology and technology of petroleum and natural gas; to maintain a high standard of professional conduct on the part of its members; and to protect the public from the work of inadequately trained and unscrupulous persons posing as petroleum geologists.

ARTICLE III. MEMBERSHIP

Members

SECTION 1. Any person engaged in the work of petroleum geology or in research pertaining to petroleum geology or technology is eligible to active membership, provided he is a graduate of an institution of collegiate standing, in which institution he has done his major work in geology, or in sciences fundamental to petroleum geology, and in addition has had the equivalent of three years' experience in petroleum geology or in the application of these other sciences to petroleum geology or to research in petroleum geology or technology; and provided further that in the case of an applicant for membership who has not had the required collegiate or university training, but whose standing in the profession is well recognized, he shall be admitted to membership when his application shall have been favorably and unanimously acted upon by the executive committee; and provided further that these requirements shall not be construed to exclude teachers and research workers in recognized institutions, whose work is of such character as in the opinion of the executive committee shall qualify them for membership.

Active members alone shall be known as members.

Life Members

SECTION 2. The executive committee may grant life membership to members who have paid their dues and are otherwise qualified.

Associates

SECTION 3. Any person having completed as much as thirty hours of geology (an hour shall here be interpreted as meaning as much as sixteen recitation or lecture periods of one hour each, or the equivalent in laboratory) in a reputable institution of collegiate or university standing, or who has done field work equivalent to this, is eligible to associate membership, provided at the time of his application for membership he shall be engaged in geological studies in an institution of collegiate or university standing, or shall be engaged in petroleum geology; and any person who is a graduate of an institution of collegiate standing in which he has done his major work in sciences fundamental to petroleum geology or petroleum technology, and who has the equivalent of one year's experience in the application of his science to the study of petroleum geology, shall be eligible to associate membership, provided at the time of his application for membership he shall be engaged in investigations in the broader subject of petroleum geology and technology.

Associate members shall be known as associates.

Associates shall enjoy all the privileges of membership in the Association, save that they shall not hold office, sign applications for membership, or vote; neither shall they have the privilege of advertising their affiliation with the Association in professional cards or professional reports or otherwise.

The executive committee may advance to active membership, without the formality of application for such change, those associates who have, subsequent to election, fulfilled the requirements for active membership.

Election to Membership

SECTION 4. Every candidate for admission as a member or associate shall submit a formal application on an application form authorized by the executive committee, signed by him, and endorsed by not less than three members who are in good standing, stating his training and experience and such other facts as the executive committee shall from time to time prescribe. Provided the executive committee, after due consideration, shall judge that the applicant's qualifications meet the requirements of the constitution, they shall cause to be published in the *Bulletin* the applicant's name and the names of his sponsors. If, after at least thirty days have elapsed since such publication, no reason is presented why the applicant should not be admitted, he shall be deemed eligible to membership or to associate membership, as the case may be, and shall be notified of his election.

SECTION 5. An applicant for membership, on being notified of his election in writing, shall pay full membership dues for the current year and on making such payment shall be entitled to receive the entire *Bulletin* for that year. Unless payment of dues is made within thirty (30) days by those living within the continental United States and within ninety (90) days by those living elsewhere, after notice of election has been mailed, the executive committee may rescind the election of the applicant. Upon payment of dues, each applicant for membership shall be furnished with a membership card for the current year, and until such written notice and card are received, he shall in no way be considered a member of the Association.

Honorary Members

SECTION 6. The executive committee may from time to time elect as honorary members persons who have contributed distinguished service to the

cause of petroleum geology. Honorary members shall not be required to pay dues.

ARTICLE IV. OFFICERS AND THEIR DUTIES

Officers

SECTION 1. The officers of the Association shall be a president, a vice-president, a secretary-treasurer, and an editor. These, together with the past president, shall constitute the executive committee and managers of the Association.

SECTION 2. The officers shall be elected annually from the Association at large by written ballot deposited in a locked ballot box by those members, present at the annual meeting, who have paid their current dues and are otherwise qualified under the constitution. Each candidate, when voted for as a candidate for the particular office for which he is nominated, shall be thereby automatically voted for as a candidate for the executive committee for one year, except that candidates for the presidency shall be automatically voted for as candidate for the executive committee for two years.

SECTION 3. No one shall hold the office of president for two consecutive years and no one shall hold any other office for more than two consecutive years except the editor who shall not hold office for more than six consecutive years.

Duties of Officers

SECTION 4. The president shall be the presiding officer at all meetings of the Association, shall take cognizance of the acts of the Association and of its officers, shall appoint such committees as are required for the purposes of the Association, and shall delegate members to represent the Association. He may, at his option, serve on, and may be chairman of, any committee.

SECTION 5. The vice-president shall assume the office of president in case of a vacancy from any cause in that office and shall assume the duties of president in case of the absence or disability of the latter.

SECTION 6. The secretary-treasurer shall assume the duties of president in case of the absence of both the president and vice-president. He shall have charge of the financial affairs of the Association and shall annually submit reports as secretary-treasurer covering the fiscal year. He shall receive all funds of the Association, and, under the direction of the executive committee, shall disburse all funds of the Association. He shall cause an audit to be prepared annually by a public accountant at the expense of the Association. He shall give a bond, and shall cause to be bonded all employees to whom authority may be delegated to handle Association funds. The amount of such bonds shall be set by the executive committee and the expense shall be borne by the Association. The funds of the Association shall be disbursed by check as authorized by the executive committee.

SECTION 7. The editor shall be in charge of editorial business, shall submit an annual report of such business, shall have authority to solicit papers and material for the *Bulletin* and for special publications, and, with the approval of the executive committee, may accept or reject material offered for publication. He may appoint associate, regional, and special editors.

SECTION 8. The officers shall assume the duties of their respective offices immediately after the annual meeting in which they are elected.

ARTICLE V. EXECUTIVE COMMITTEE—MEETINGS AND DUTIES

Executive Committee

SECTION 1. The executive committee shall consist of the president, past president, vice-president, secretary-treasurer, and editor.

Meetings and Duties

SECTION 2. The executive committee shall meet immediately preceding the annual meeting and at the call of the president may hold meetings when and where thought advisable, to conduct the affairs of the Association. A joint meeting of the outgoing and incoming executive committees shall be held immediately after the close of the annual Association business meeting. Members of the executive committee may vote by proxy on matters which require a unanimous vote.

SECTION 3. The Executive committee shall consider all nominations for membership and pass on the qualifications of the applicants; shall have control and management of the affairs and funds of the Association; shall determine the manner of publication and pass on the material presented for publication; and shall designate the place of the annual meeting. They are empowered to establish a business headquarters for the Association, and to employ such persons as are needed to conduct the business of the Association. They are empowered to accept, create, and maintain special funds for publication, research, and other purposes. They are empowered to make investments of both general and special funds of the Association. Trust funds may be created giving to the trustees, appointed for such purpose such direction as to investments as seems desirable to the executive committee to accomplish any of its objects and purposes, but no such trust funds shall be created unless they are revocable upon ninety (90) day's notice.

ARTICLE VI. MEETINGS

The Association shall hold at least one stated meeting each year, which shall be the annual meeting. This meeting shall be held in March at a time and place designated by the executive committee. At this meeting the election of members shall be announced, the proceedings of the preceding meeting shall be read, Association business shall be transacted, scientific papers shall be read and discussed, and officers for the ensuing year shall be elected.

ARTICLE VII. AMENDMENTS

Amendments to this constitution may be proposed by a resolution of the executive committee, by a constitutional committee appointed by the president, or in writing by any ten members of the Association. All such resolutions or proposals must be submitted at the annual meeting of the business committee of the Association as provided in the by-laws, and only the business committee shall make recommendations concerning proposed constitutional changes at the annual Association business meeting. If such recommendations by the business committee shall be favorably acted on at the annual Association business meeting, the secretary-treasurer shall arrange for a ballot of the membership by mail within thirty (30) days after said annual Association business meeting, and a majority vote of the ballots received within ninety (90) days of their mailing shall be sufficient to amend. The legality of all amendments must be determined by the executive committee prior to balloting.

BY-LAWS

ARTICLE I. DUES

SECTION 1. The fiscal year of the Association shall correspond with the calendar year.

SECTION 2. The annual dues of members of the Association shall be ten dollars ($10.00). The annual dues of associates for not to exceed three years after election shall be six dollars ($6.00); for the second three-year period eight dollars ($8.00); thereafter, the annual dues of such associates shall be ten dollars ($10.00). The annual dues are payable in advance on the first day of each calendar year. A bill shall be mailed to each member and associate before January first of each year, stating the amount of the annual dues and the penalty and conditions for default in payment. Members or associates who shall fail to pay their annual dues by April first shall not receive copies of the April *Bulletin* or succeeding *Bulletins*, nor shall they be privileged to buy Association special publications at prices made to the membership, until such arrears are met.

SECTION 3. On the payment of two hundred dollars ($200.00) any member in good standing shall be declared a life member and thereafter shall not be required to pay annual dues. The funds derived from this source shall be placed in a permanent investment, the income from which shall be devoted to the same purposes as the regular dues.

ARTICLE II. RESIGNATION—SUSPENSION—EXPULSION

SECTION 1. Any member or associate may resign from the Association at any time. Such resignation shall be in writing and shall be accepted by the executive committee, subject to the payment of all outstanding dues and obligations of the resigning member or associate.

SECTION 2. Any member or associate who is more than a year delinquent (in arrears) in payment of dues shall be suspended from the Association. Any delinquent or suspended member or associate, at his own option, may request in writing that he be dropped from the Association and such request shall be granted by the executive committee. Any member or associate more than two years in arrears shall be dropped from the Association. The time of payment of delinquent dues for either one year or two years may be extended by unanimous vote of the executive committee.

SECTION 3. Any member or associate who resigns or is dropped under the provisions of sections 1 and 2 of this article ceases to have any rights in the Association and ceases to incur further indebtedness to the Association.

SECTION 4. Any person who has ceased to be a member or associate under Section 1 or Section 2 of this article may be reinstated by unanimous vote of the executive committee subject to the payment of any outstanding dues and obligations which were incurred, prior to the date when he ceased to be a member or associate of the Association.

In the case of any member or associate who has been dropped between the dates of January 1, 1931, and January 1, 1936, for non-payment of dues and who shall apply for reinstatement, the executive committee is authorized, at its discretion, to accept the resignation of such member or associate effective at any date during such period of delinquency, provided, the member shall pay all indebtedness to the Association incurred prior to the date of such resignation including a proper proportion of annual dues as shall be

fixed by the executive committee. Such member or associate shall not be entitled to receive the *Bulletin* for any period subsequent to the date when his resignation became effective and prior to his reinstatement.

SECTION 5. Any member or associate who, after being granted a hearing by the executive committee, shall be found guilty of a violation of the code of ethics of this Association or shall be found guilty of a violation of the established principles of professional ethics, or shall be found guilty of having made a false or misleading statement in his application for membership in the Association, may be suspended or expelled from the Association by unanimous vote of the executive committee. The decision of the executive committee in all matters pertaining to the interpretation and execution of the provisions of this section shall be final.

ARTICLE III. PUBLICATIONS

SECTION 1. The proceedings of the annual meeting and the papers presented at such meeting shall be published at the discretion of the executive committee in the Association *Bulletin* or in such other form as the executive committee may decide best meets the needs of the membership of the Association.

SECTION 2. The payment of annual dues for any fiscal year entitles the member or associate to receive without further charge a copy of the *Bulletin* of the Association for that year.

SECTION 3. The executive committee may authorize the printing of special publications to be financed by the Association from its general, publication, or special funds and offered for sale to members and associates in good standing at not less than the cost of publication and distribution.

ARTICLE IV. REGIONAL SECTIONS, TECHNICAL DIVISIONS, AND AFFILIATED SOCIETIES

SECTION 1. Regional sections of the Association may be established provided the members of such sections are members of the Association and shall perfect an organization and make application to the executive committee. The executive committee shall submit the application to a vote at a regular annual meeting, an affirmative vote of two-thirds of the members present and voting being necessary for the establishment of such a section; and provided that the Association may revoke the charter of any regional section by a vote of two-thirds of the members present and voting at a regular annual meeting.

SECTION 2. Technical divisions may be established, provided the members interested shall perfect an organization and make application to the executive committee. The executive committee shall submit the application to a vote at a regular meeting, an affirmative vote of two-thirds of the membership present and voting being necessary for the establishment of such a division. In like manner, the Association may dissolve a division by an affirmative vote of two-thirds of the members present and voting at any annual meeting. A technical division may have its own officers, and it may have its own constitution and by-laws provided that, in the opinion of the executive committee, these do not conflict with the constitution and by-laws of the Association. The executive committee shall be empowered to make arrangements with the officers of the division for the conduct of the business of the division. A divi-

sion may admit to affiliate membership in the division specially qualified persons who are not eligible to membership in the Association. Technical divisions may affiliate with other scientific societies, with the approval of the executive committee.

SECTION 3. Subject to the affirmative vote of two-thirds of the membership present and voting at an annual meeting, and with legal advice, the executive committee may arrange for the affiliation with the Association of duly organized groups or societies, which by object, aims, constitution, by-laws, or practice are developing the study of geology or petroleum technology. In like manner and with like advice, the executive committee may arrange conditions for dissolution of such affiliations. Affiliation with the Association need not prevent affiliation with other scientific societies. Members of affiliated societies who are not members of the Association, shall not have the privilege of advertising their affiliation with the Association on professional cards or otherwise.

ARTICLE V.. DISTRICT REPRESENTATIVES

The executive committee shall cause to be elected district representatives from districts which it shall define by a local geographic grouping of the membership. Such districts shall be redesignated and redefined by the executive committee as often as seems advisable. Each district shall be entitled to one representative for each seventy-five members, but this shall not deprive any designated district of at least one representative. The representatives so apportioned shall be chosen from the membership of the district by a written ballot arranged by the executive committee. They shall hold office for two years, their term of office expiring at the close of the annual meeting.

ARTICLE VI. BUSINESS COMMITTEE

There shall be a business committee to act as a council and advisory board to the executive committee and the Association. This committee shall consist of the executive committee, not more than five members at large appointed by the president, two members elected by and from each technical division, and the district representatives. The president shall also appoint a chairman and a vice-chairman, but neither of these need be one of those otherwise constituting the business committee. The secretary-treasurer shall act as secretary of the business committee. If a district or technical representative is unable to be present at any meeting of the committee he may designate an alternate, who, in the case of a district representative, may or may not be a resident of the district he is asked to represent, and the alternate, on presentation of such a designation in writing, shall have the same powers and privileges as a regularly chosen representative. The business committee shall meet the day before the annual meeting at which all proposed changes in the constitustitution or by-laws shall be considered, all old and new business shall be discussed, and recommendations shall be voted for presentation at the annual meeting.

ARTICLE VII. AMENDMENTS

These by-laws may be amended by vote of three-fourths of the members present and voting at any annual meeting, provided that such changes shall have been recommended to the meeting by the business committee and provided that their legality shall be determined by the executive committee prior to publication.

BULLETIN OF THE AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS
VOL. 20, NO. 5 (MAY, 1936), PP. 673-676

AT HOME AND ABROAD

CURRENT NEWS AND PERSONAL ITEMS OF THE PROFESSION

J. E. HESTON has recently been transferred from the Cities Service Company, 60 Wall Street, New York City, to the Empire Gas and Fuel Company, Hobbs, New Mexico, where he is now employed as production engineer.

F. W. ROHWER has accepted the position of chief geologist for the Antilles Petroleum Company (Trinidad), Limited (recently organized subsidiary of the McColl-Frontenac Oil Company, Montreal, Canada), 7 High Street, San Fernando, Trinidad, B. W. I.

THOMAS E. WALL has moved from Ramsey Tower, Oklahoma City, Oklahoma, to 1426 Esperson Building, Houston, Texas.

CECIL D. ROBINSON, geologist for the Arkansas Natural Gas Corporation, has been transferred from Russellville, Arkansas, to Texarkana, Arkansas (Box 117), where he will do geological work in the Rodessa area.

GEORGE A. WEAVER has changed his address to 601 Ratcliff Street, Shreveport, Louisiana.

FREDERICK S. LOTT is now employed under a temporary appointment by the Bureau of Mines. His address is Hotel Claridge, 820 Connecticut Avenue, Washington, D.C.

RAY B. ANDERSON, formerly with Sinclair-Prairie, has accepted a position with the Columbian Carbon Company, Box 1240, Charleston, West Virginia.

CARL C. ADDISON has changed his address to Pure Oil Company, Box 2107, Fort Worth, Texas.

D. GLYNN JONES' new address is, in care of Tanyrallt, 63 Woodville Road, Mumbles, Swansea, Gloucester, Great Britain.

GEORGE E. WAGONER has changed his address from Box 801, Tulsa, Oklahoma, to the Stanolind Oil Company of Louisiana, Shreveport, Louisiana.

PHIL MONTGOMERY has moved from Chickasha, Oklahoma, and his new address is Halliburton Oil Well Cementing Company, Box 205, Kilgore, Texas.

R. M. BEATTY has changed his address from 3707 Graustark, Houston, Texas, to 602 Milam Building, San Antonio, Texas.

ADOLPH DOVRE, district geologist for the Tide Water Oil Company for the past seven years, has resigned and will engage in independent geological work in San Antonio, his office being 710 Milam Building.

The new officers of the Panhandle Geological Society, Amarillo, Texas, are: president, JOHN E. GALLEY, Shell Petroleum Corporation, Amarillo;

vice-president, GENTRY KIDD, Stanolind Oil and Gas Company, Pampa; secretary-treasurer, DANA M. SECOR, Skelly Oil Company, Pampa, Texas. J. D. THOMPSON, JR., was re-elected as the Association business representative.

WALTER E. HOPPER, engineer-geologist in the royalty division of the Securities Exchange Commission at Washington, D. C., spoke at a meeting of the Mid-Continent Royalty Owners Association at Tulsa, Oklahoma, March 17.

CLAUDE P. PARSONS, vice-president of the Halliburton Oil Well Cementing Company, spoke on "The Use of Penetrating Acids," before the Mid-Continent Section of the American Institute of Mining and Metallurgical Engineers at Tulsa, March 23.

R. D. OHRENSCHALL of the Shell Petroleum Corporation gave an illustrated "Geologic Travelogué in Koyukuk, Alaska," at the Tulsa Geological Society meeting, April 6.

The officers of the Alberta Society of Petroleum Geologists, Calgary, Alberta, for the present year are: chairman, R. V. JOHNSON; vice-chairman, J. G. SPRATT; business manager, F. M. STEEL; secretary, B. L. THORNE; members of the executive committee, T. B. WILLIAMS, J. S. IRWIN and S. E. SLIPPER.

On March 14 the Ardmore, Oklahoma, Geological Society took a field trip for the purpose of studying the Pennsylvanian of the Ardmore basin. On April 4 another was made to study the pre-Pennsylvanian of the Ardmore area. On April 18, on a trip to the Wichita Mountains, the Permian was studied en route and at the Wichitas typical exposures of the Cambro-Ordovician were discussed. On May 5 a technical session included the following papers: "Correlation between the Pennsylvanian of the Ardmore Basin and North-Central Texas," by MAYNARD P. WHITE; "Correlation between the Pennsylvanian of the Ardmore Basin and the Fitts Graben," by JEROME WESTHEIMER; "Correlation of the Pennsylvanian from the Fitts Graben to Southern Kansas," by ED. MINNIS.

W. O. THOMPSON gave a paper on the "Original Structures in Various Kinds of Sandstones" at the regular meeting of the Rocky Mountain Association of Petroleum Geologists, Denver, Colorado, April 6.

E. G. GAYLORD, of the Standard Oil Company of California, San Francisco, California, has been appointed chairman of the American Petroleum Institute's advisory committee on fundamental research on occurrence and recovery of petroleum. Members of the committee, also appointed by George A. Hill, Jr., of the Houston Oil Company, Houston, Texas, chairman of the Institute's Division of Production general committee, follow: F. R. CLARK, Mid-Kansas Oil and Gas Company, Tulsa, Oklahoma; K. C. HEALD, Gulf Oil Corporation of Pennsylvania, Pittsburgh, Pennsylvania; W. B. HEROY, Consolidated Oil Corporation, New York; F. H. LAHEE, Sun Oil Company, Dallas, Texas; A. W. MCCOY, Marland Oil Company of Oklahoma, Ponca City, Oklahoma; C. V. MILLIKAN, Amerada Petroleum Corporation, Tulsa,

Oklahoma; K. B. NOWELS, Forest Development Corporation, Tulsa; R. D. REED, The Texas Company of California, Los Angeles; A. C. RUBEL, Union Oil Company of California, Los Angeles; W. C. SHUTTS, Standard Oil Development Company, New York; H. D. WILDE, JR., Humble Oil and Refining Company, Houston; and F. E. WOOD, Standard Oil Company (Indiana), Chicago. C. A. YOUNG, secretary of the Division of Production, is also committee secretary.

At the spring meeting of the southwestern district of the Division of Production of the American Petroleum Institute at Shreveport, Louisiana, April 9, 10 and 11, several papers on geology and production were presented on the first day. C. E. CHASE, of The Pure Oil Company, presided, and state geologist C. K. MORESI, of New Orleans, spoke. HENRY V. HOWE, of Louisiana State University at Baton Rouge, gave a paper on "Louisiana Petroleum Stratigraphy;" JOHN S. JOY, of the United Gas Company, Houston, described the "Rodessa Oil Field;" and C. P. PARSONS, of the Halliburton Oil Well Cementing Company, presented "Highlights and Personalities of the Southwestern District," a motion picture.

The fourth annual Mineral Industries Conference of Illinois, at Urbana, sponsored by the Illinois State Geological Survey Division of the Department of Registration and Education, the Engineering Experiment Station of the University of Illinois, and the Illinois Mineral Industries Committee, included in its program of April 24 a forum on oil and gas researches, A. H. BELL, leader, consisting of the following papers: "Researches on the Underground Geology of Illinois," by L. E. WORKMAN; "Studies of Outcropping Strata in the Illinois Basin," by J. M. WELLER; "Studies of Repressuring and Water Flooding," by A. H. BELL; "Flow of Fluids through 'Oil Sands,' " by R. J. PIERSOL; "Training in Petroleum Engineering," by R. F. LARSON. On April 25, a forum on oil and gas, WILLIAM BELL, chairman, included: "A Comprehensive Survey of Reserves and Underground Conditions in Illinois Oil Fields," by WILLIAM BELL; "Problems in Improved Oil Recovery," by MILLARD FLOOD; "The Permeability of Oil Sands in Relation to Improved Recovery," by W. S. CORWIN; "Present Status and Future Possibilities of Acid Treatment in Illinois Fields" (speaker to be announced); "Relation of Imports and Exports of Petroleum to the Domestic Industry," by W. H. VOSKUIL.

E. DEGOLYER has purchased a home in Dallas and will move his family from Montclair, New Jersey, within a few months.

TOM B. ROMINE, geologist for Sinclair-Prairie Oil Company in the Corpus Christi area, has been transferred to the southern district headquarters at Fort Worth, and will be succeeded by DALE BENSON, who was formerly stationed at Amarillo.

EVAN JUST, formerly Oklahoma district engineer for the Carter Oil Company, has been made district petroleum engineer for that company in the Seminole district.

JOHN M. LOVEJOY, New York, president of Seaboard Oil Company, and president of the American Institute of Mining and Metallurgical Engineers,

was in Houston, April 2. He spoke at a joint meeting of the Houston Geological Society and Gulf Coast Section of the American Institute of Mining and Metallurgical Engineers.

E. DeGolyer has been appointed chairman of the special committee of the American Institute of Mining and Metallurgical Engineers to draw plans for the new Lucas award for outstanding achievement in oil production engineering. Later an award committee will be named so that a candidate may be presented at the next annual meeting in February, 1937.

A. Morley Davies' book, *Tertiary Faunas, Vol. I, The Composition of Tertiary Faunas*, was incorrectly priced in the March and April *Bulletins*. The price is 22s, 6d. It may be purchased from Thomas Murby and Company, 1 Fleet Lane, London, E. C. 4.

Roy M. Butters is with the Tennessee Valley Authority as assistant mining engineer in charge of phosphate prospecting. His address is 1,000 West Seventh Street, Columbia, Tennessee.

W. A. J. M. van Waterschoot van der Gracht, of Heerlen, Holland, has accepted the invitation of the University of London to deliver a series of three addresses on geology early in 1937.

L. L. Hutchison, 602 West Grand, McAlester, Oklahoma, is in charge of the minerals survey of Pittsburg, Latimer and Le Flore counties.

Ivan J. Fenn is employed by the J. M. Huber Petroleum Company, Box 278, Borger, Texas.

NEW HEADQUARTERS LOCATION

In accordance with the decision of the executive committee at the twenty-first annual meeting in Tulsa, March 21, 1936, the Association headquarters office is now situated in a suite of rooms at 608 Wright Building. There is no change in the post-office address which is Box 1852, Tulsa, Oklahoma. Association headquarters and a paid full-time staff were authorized and established in 1926 and offices were opened on the top floor of the Tulsa Public Library Building in July of that year. On completion of the Tulsa Chamber of Commerce and Tulsa Club Building in 1927, the offices were moved to the fifth floor of that building, in accordance with the plans when the Tulsa Geological Society invited the Association to make Tulsa its headquarters. Now, on May 1, 1936, within two months of the tenth anniversary of the establishment of full-time headquarters, the Association is situated at 608 Wright Building between the Post-Office Building and the Public Library Building. Members and prospective members are invited to inspect the new offices.